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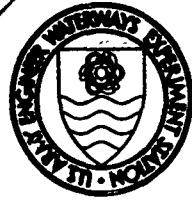
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**PREDICTIVE ANALYSIS OF DISSOLVED OXYGEN IN
DICKEY LAKE, MAINE**

**ARMY ENGINEER WATERWAYS EXPERIMENT STATION
VICKSBURG, MISSISSIPPI**

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PREDICTIVE ANALYSIS OF DISSOLVED OXYGEN IN DICKEY LAKE, MAINE

by

Kent W. Thornton

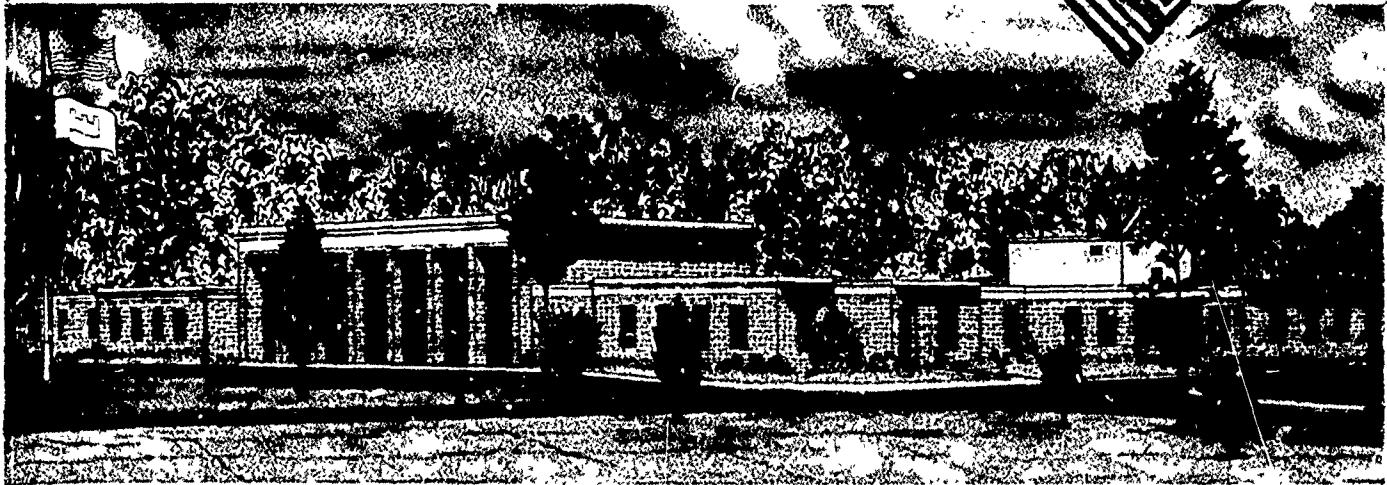
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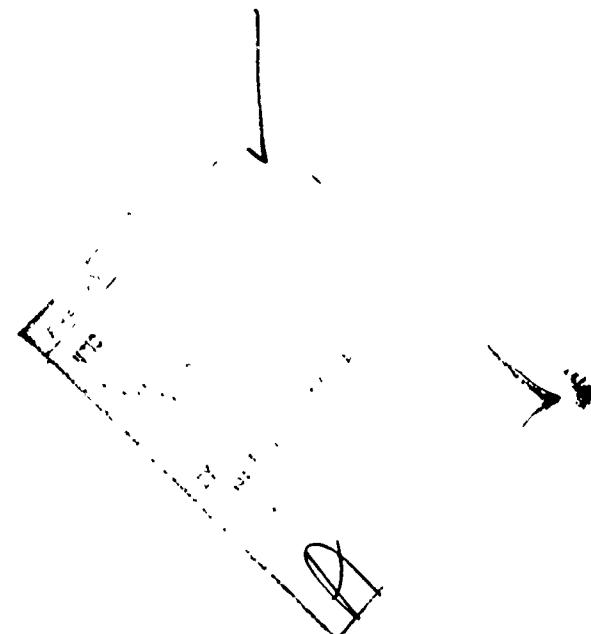
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20. ABSTRACT (Continued)

approach was a comparison of the temperature and DO regimes found in 25 lakes located in Maine, Vermont, New York, and Quebec, Canada. An attempt was made to select lakes that had similar depths, surface areas, and geographic locations with respect to Dickey Lake. This information was used to project the DO regime expected in the far field in Dickey Lake, out of the direct influence of the pumpback jet, and to arrive at general conclusions concerning some of the coves and embayments. The second approach was an attempt to bound the DO expected during the incremental filling period. This was accomplished by selecting appropriate benthic and water oxygen uptake rates from the literature and calculating the potential hypolimnetic DO concentrations at the end of the summer stratification period.

Based on a comparison of the 25 lakes, Dickey Lake is expected to be a dimictic, holomictic lake that freezes over during the winter. The far-field DO in Dickey Lake after stabilization is expected to be near saturation in the epilimnion and at or above 6 mg/l in the hypolimnion at the end of the summer stratification period. The DO may be lower in the coves and embayments, approaching 2 mg/l at isolated times in the hypolimnion of the shallower coves, depending upon mesoclimatological events.

Dickey Lake is expected to have 5 mg/l of DO in the hypolimnion by the second year after complete filling and possibly earlier. During the filling period, the reservoir may become meromictic, but it is expected to be holomictic after pumpback operations begin. The reservoir is expected to stabilize in 6 to 9 yr after filling.



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PREFACE

The work described in this report was performed by the U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Mississippi, for the U. S. Army Engineer Division, New England (NED). The project was authorized by Intra-Army Order for Reimbursable Services No. 76-C-T-017 dated 24 September 1976.

This report describes a preliminary evaluation of the dissolved oxygen (DO) regime that might be expected in the proposed Dickey Lake. It is intended to provide information for the environmental impact statement and feature water-quality design memorandum. It does not represent a complete or comprehensive analysis of DO in the proposed Dickey Lake. Some areas of interest could not be evaluated with the existing data base or within the time frame of this study.

The project was undertaken by the Environmental Effects Laboratory (EEL) at the WES. The research was conducted under the direct supervision of Mr. D. L. Robey, Chief, Ecosystem Modeling Branch, and under the general supervision of Drs. R. L. Eley, Chief, Ecosystem Research and Simulation Division, and John Harrison, Chief, EEL. Dr. K. W. Thornton served as principal investigator.

Messrs. Richard DiBuono and Richard Cassidy, NED, provided information throughout the study and, along with Mr. David Buelow, assisted in data collection, provided thermal simulations of Dickey Lake, and reviewed the study. Messrs. D. G. Fontane and M. S. Dortch, Hydraulics Laboratory, WES, provided information on the structural design of the dam and outlet works, hydrodynamics during operation, and reviewed the study. Dr. D. E.

Ford and Mr. Robey, EEL, provided assistance throughout the course of the study.

Data on the study lakes were provided by Dr. Ray Oglesby, Department of Natural Resources, Cornell University; Dr. E. Bennett Henson, Department of Zoology, University of Vermont; Mr. Matthew Scott, Department of Environmental Protection, State of Maine; and the Quebec Province Service of Water Quality, Quebec, Canada.

Director of the WES during the preparation and publication of this report was COL J. L. Cannon, CE. Technical Director was Mr. F. R. Brown.

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PREDICTIVE ANALYSIS OF DISSOLVED
OXYGEN IN DICKEY LAKE, MAINE

Introduction

Knowledge of the dissolved oxygen (DO) in a body of water provides as much information about the system as any other single variable (Hutchinson, 1957). Since DO concentrations integrate as well as regulate many of the biological and chemical phenomena that occur in a water body, it is important to analyze changes that occur in the DO regime throughout the year in a lake or reservoir. These changes become especially important when a part of the system becomes isolated. During thermal stratification, the hypolimnion in a natural lake effectively becomes isolated from gaseous exchange with the rest of the lake. Advection resulting from inflows and project operations, however, may result in aerated water entering the hypolimnion of a reservoir. Since diffusion of gases in water is a slow process, the lake must circulate to maintain an equilibrium with atmospheric oxygen (Wetzel, 1975). Changes that occur in the hypolimnetic DO during this period may significantly affect lake or reservoir water quality and biota. It is important, therefore, for many activities and operational and management objectives to be able to predict the DO regime that will exist in a water body throughout the year.

Dickey Lake is a proposed impoundment on the Saint John River in northern Maine. The impoundment proposed by the U. S. Army Engineer Division, New England (NED), would extend 75 km upstream behind a 102.1-m-high dam. Project purposes include peaking power generation (including pumpback operation), flood control, and general recreation.

Specific morphometric characteristics of the proposed Dickey Lake are listed in Table 1. If constructed, Dickey Lake would become the second largest and deepest lake in New England. Lake Champlain would be its only sovereign (Cassidy, 1975).

The Dickey Lake project is presently in the preconstruction planning phase. During the preparation of the environmental impact statement and the feature water-quality design memorandum, questions arose concerning the DO regime expected in Dickey Lake. This report presents an analysis of the DO concentrations projected to occur in the proposed Dickey Lake.

The report is divided into four areas. The first part is a comparison of DO and temperature regimes in northeastern North American lakes. This approach was used to obtain an estimate of the DO and temperature regime expected after stabilization if Dickey Lake is constructed. The second part consists of predictions of potential hypolimnetic DO concentrations during the filling period. Various oxygen uptake rates were used to calculate a band of possible DO values. The third part discusses possible DO and temperature regimes within the coves and embayments. The fourth part elaborates on several of the assumptions implicit in the analysis of DO in this study.

Comparison of DO in Surrounding Lakes

DO data were obtained from several sources on a total of 25 lakes located in Maine, Vermont, New York, and the province of Quebec, Canada. Specific morphometric characteristics of the lakes and sources of information are listed in Tables 1 and 2, respectively. The approximate locations

of the lakes are shown in Figure 1. An attempt was made to include lakes of similar depth, surface area, and geographic location with respect to Dickey Lake. Several lakes were much smaller and shallower than Dickey Lake but were included because of similar geographic location and because data from the lakes would provide some insight into the potential behavior of some of the coves in Dickey Lake.

The water bodies included in the analyses are natural lakes since there are no large reservoirs the size of Dickey Lake in the Northeast. Moosehead Lake and Lake Aylmer both have had dams added to raise their pool elevation for power production, but a natural lake was in existence prior to the structural addition. Although Dickey Lake will be a reservoir and not a natural lake, the analysis was to be conducted for the far field, out of the direct influence of the pumpback jet, and thus the comparison with natural lakes should result in a reasonable estimate of DO for the reservoir. The theoretical residence times of several of the lakes are also comparable with Dickey Lake and add support to the comparison. Bailey (1975) determined the residence time of Embden Pond to be 3.6 yr, while the U. S. Environmental Protection Agency (1975) determined the residence times for Champlain, Moosehead, Rangeley, Sebago, Cayuga, and Long Lakes to be 2.6, 3.0, 2.8, 5.4, 11.2, and 3.2 yr, respectively. The theoretical residence time for Dickey Lake was calculated to be 2.3 yr. The long residence time should lessen the effects of inflow-outflow dynamics on the overall DO balance in the pool. Eley (1970) found that inflow and outflow accounted for less than 1 percent of the daily gains and losses of DO, respectively, in

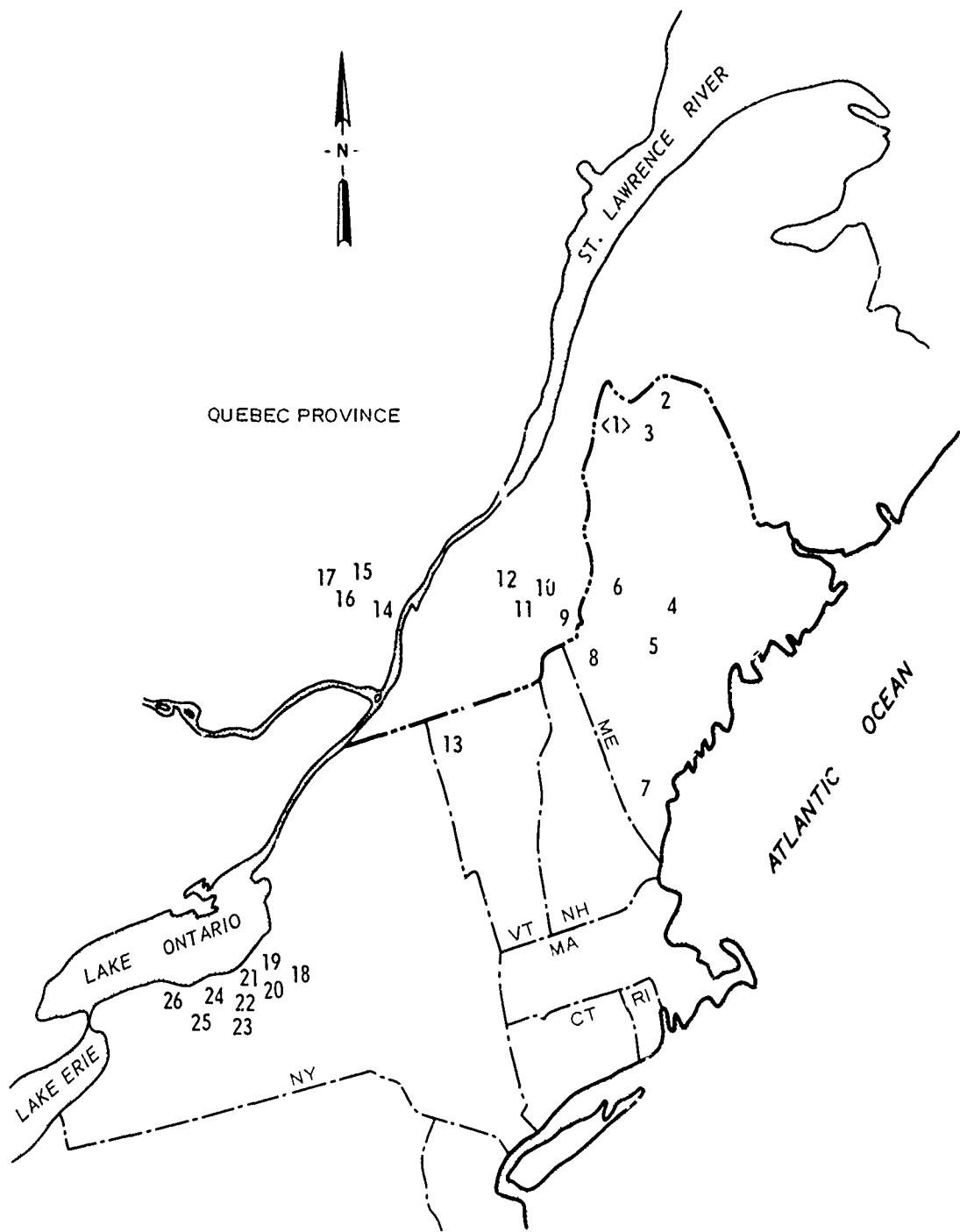


Figure 1. Location of Dickey Lake (No. 1) and 25 study lakes. See Table 1 for lake names corresponding to the numbers shown on the map

the Cimarron Arm of Keystone Reservoir, Oklahoma. Keystone Reservoir had a theoretical retention time of only 20 days and an observed residence time of 6 to 48 days. It is expected, therefore, that biological and chemical processes and atmospheric exchanges will dominate the overall DO balance in the proposed Dickey Lake.

Temperature and DO data for the 25 study lakes have been tabulated by date and depth in Appendix A. Composites of these data are presented in Figures 2 and 3. Temperature and DO maxima and minima are displayed in Figure 2 to provide an indication of the range of temperatures and DO concentrations that have been recorded in these lakes. The monthly DO means and standard errors are plotted in Figure 3 to provide an estimate of average DO concentrations that have been recorded for the study lakes.

Aerobic conditions were found at all depths for all times of the year in all 25 study lakes (Figure 2). The DO concentrations ranged from 1.7 to 15.7 mg/l (Figure 2). On the average, however, DO concentrations rarely decreased below 7 mg/l for all months of the year (Figure 3). The greatest variation appeared in depths of 50 m or less and reflected the inclusion of several of the smaller, shallower lakes and, possibly, metalimnetic DO demand in the larger lakes.

The hypolimnetic DO concentrations below 50 m, in general, were above 6 mg/l throughout the year within a relatively narrow range (Figure 2). Hypolimnetic DO concentrations average between 10 to 12 mg/l during the first half of the year and between 8 to 10 mg/l during the second half of the year (Figure 3). The DO dropped to 3.4 mg/l at 120 m in Cayuga Lake on 8 July 1972, but was recorded at 7.8 mg/l at the same depth and

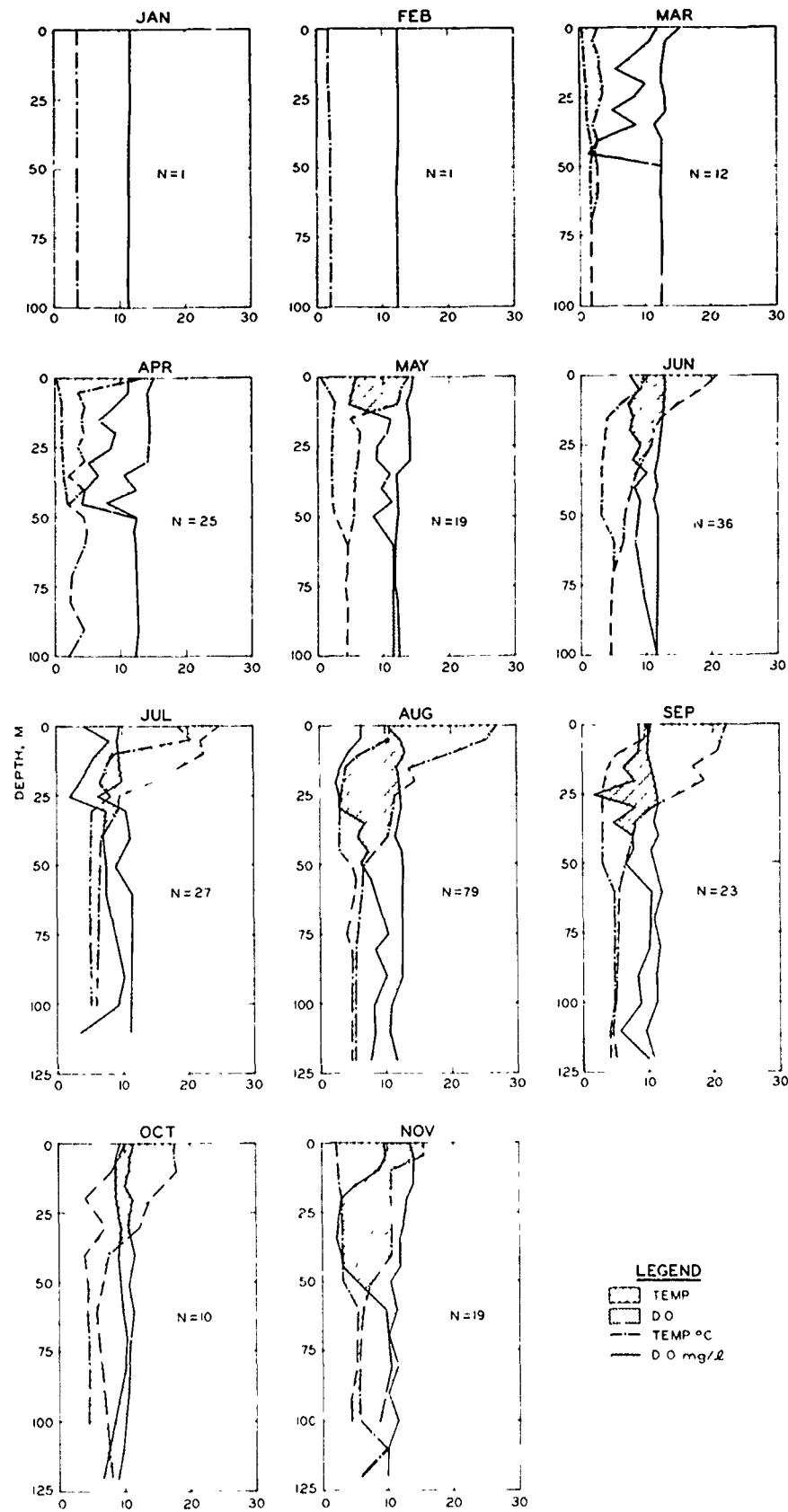


Figure 2. Monthly DO and temperature bands between maxima and minima values for the 25 study lakes

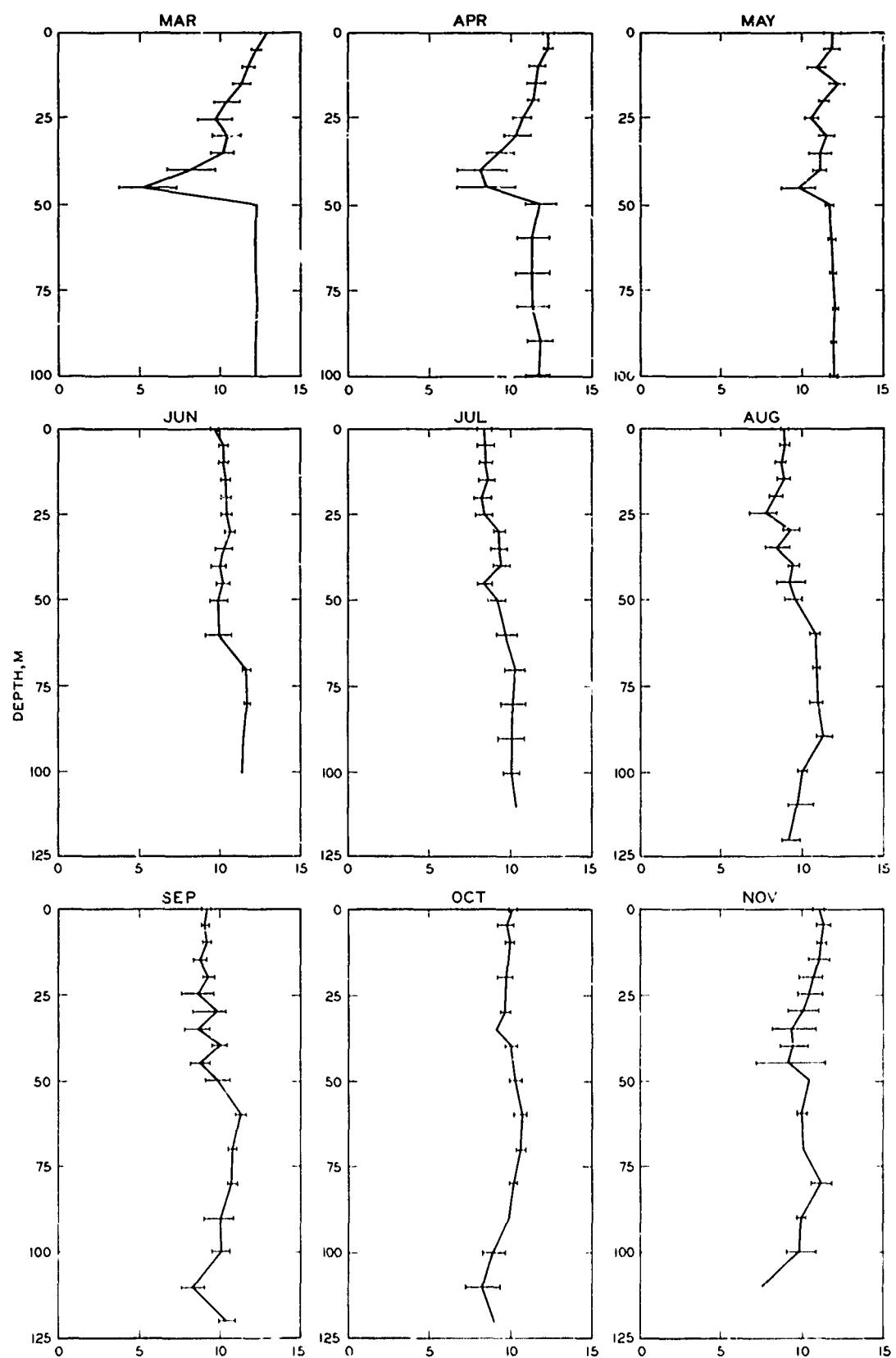


Figure 3. Monthly DO means and standard errors
for the 25 study lakes

location on 2 August 1972. If one sampled at enough locations through time, it is expected that more of these isolated pockets of low DO would be recorded, but it is questionable how long they would exist before the oxygen deficit was satisfied and they reached equilibrium with the surrounding water. Usually, these deep lakes do not experience low hypolimnetic DO. This may be due, in part, to two processes. At the low hypolimnetic temperatures, ranging from about 3 to 7°C, biological and chemical activity is reduced and oxygen uptake is low. Secondly, the oxidation of detrital material settling out of the epilimnion can proceed through a relatively large volume so that much of the oxygen demand of this material has been satisfied by the time it reaches the sediment.

The minimum DO concentrations as a function of depth above 50 m were highly variable (Figures 2 and 3). This resulted from the inclusion of shallower, smaller lakes in the analyses. The hypolimnetic DO near the bottom in some of these lakes did decrease to 2 to 3 mg/l and this is reflected in Figure 2. Each minima spike represents the bottom of a specific lake or cove. These spikes occur consistently between 15 to 20 m, 25 to 30 m, and 45 to 50 m, and represent the maximum depths in several of the study lakes. Although the hypolimnetic temperatures rarely increased above 10°C at depths of 30 m or greater, the volume of the hypolimnion in these lakes was not as great as in the deeper lakes. Much of the oxygen demand of the detritus probably remained to be satisfied after it reached the sediment, resulting in the lower DO concentrations in these shallower lakes. Surface DO concentrations ranged from 4.5 to 15.7 mg/l throughout the year (Figure 2). The surface concentrations, on the average,

were at or near saturation (Figure 3). At various times of the year, primary production of oxygen exceeded community respiration and the epilimnion became supersaturated with DO. However, at other times, community respiration of oxygen exceeded primary production and DO values were less than saturation. The range of DO concentrations for the study lakes was greater in the epilimnion than in the hypolimnion for two major reasons. First, less oxygen can be dissolved in water at higher temperatures, and second, biological consumption of oxygen per unit time probably was increased at the higher temperatures.

In Lake Champlain, the DO minima did not occur in the hypolimnion but in the metalimnion. Metalimnetic DO minimums occurred several times throughout the season (Henson, personal communication). The effective settling rate of epilimnetically produced organic matter decreased as it entered the metalimnion because of the density gradient; at the temperatures of the metalimnion, the readily oxidizable organic matter was decayed. This reduced the oxygen content of the metalimnion and resulted in a more stable organic compound entering the colder hypolimnetic waters where it was more slowly degraded. This resulted in lower oxygen consumption per gram of organic matter per unit time in the hypolimnion. Minimal hypolimnetic oxygen concentrations were about 7 mg/l near the end of the summer stratification period in Lake Champlain.

Hypolimnetic Oxygen Deficits during Filling

It is important to estimate the DO regime expected during the filling period and the stabilization period following filling as the reservoir approaches a steady-state condition. To assess these conditions, several assumptions were made.

It was assumed that epilimnetic DO concentrations will remain near saturation due to biological oxygen production, mixing, and circulation of the epilimnion. During the first year of filling, however, the epilimnion may be undersaturated due to benthic demand (Falter et al., 1973).

Ford (1976) found the depth to the thermocline during thermal stratification could be related to lake surface area (Figure 4). For lakes with surface areas of about 100 km^2 or greater, the thermocline depth was roughly constant at 18 m. This implies lakes with surface areas greater than 100 km^2 will have similar epilimnetic depths. This conclusion is also generally supported by data from several lakes that were included in this study as shown below.

Lake	Surface Area, km^2	Thermocline Depth, m*
Cayuga	172	20.0
Moosehead	303	15.2
Sebago	116	16.1

* Values calculated during late August or early September to reflect period of strong stratification.

Since Dickey Lake will have a surface area of 93 km^2 at the end of the first year of the filling process, the thermocline depth or point of the maximum density gradient was assumed to exist at approximately 18 m.

Since this depth also represents the point of minimal mixing, the hypolimnion was assumed to begin 18 m below the surface for all computations. The approximate hypolimnetic depths, areas, volumes, and changes in areas and volumes associated with the incremental fillings, therefore, would be as follows:

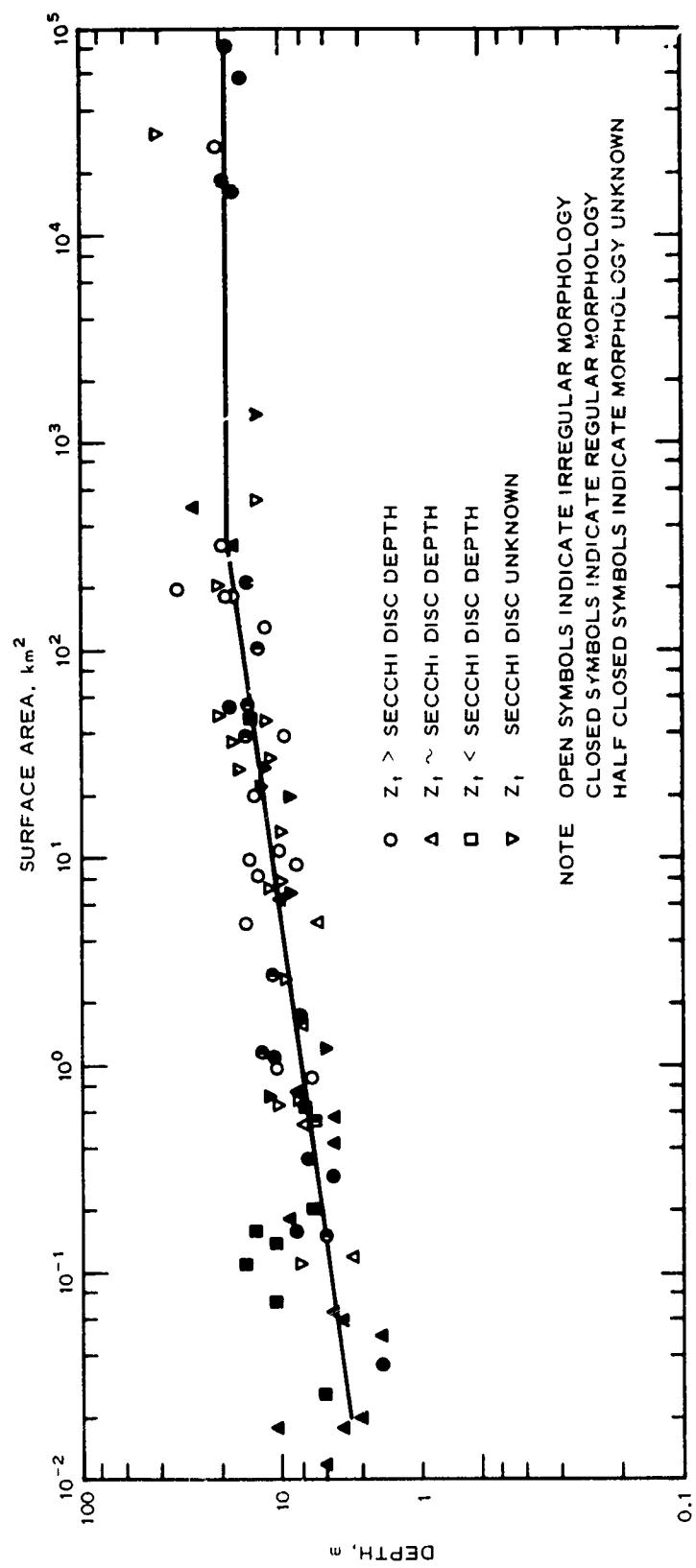


Figure 4. Thermocline depth as a function of surface area

<u>Time of Filling</u>	<u>Elevation</u> <u>m</u>	<u>Depth</u> <u>m</u>	<u>Hypolimnion</u>			
			<u>Area</u> <u>km</u> ²	<u>Δ Area</u> <u>km</u> ²	<u>Volume</u> <u>10</u> ⁹ <u>m</u> ³	<u>Δ Volume</u> <u>10</u> ⁹ <u>m</u> ³
1st spring	221.0	44.2	55.64	--	0.99	--
2nd spring	239.9	63.1	94.70	39.05	2.38	1.39
3rd spring	250.8	74.0	132.54	37.84	3.61	1.23
Final spring	259.1	82.3	175.44	42.90	4.85	1.24

Since bottom contours were not available for this study, it was assumed the inundated bottom area was similar in magnitude to lake surface area. The assumption that the surface area was roughly similar to the bottom area is reasonable. An average slope for the sides of Dickey Lake is approximately 7 deg from the horizontal. This slope will be greater near the dam but less in the headwater area. Ignoring surface irregularities, this slope will produce bottom areas that are roughly 1.01 times greater than the surface area (Dortch, personal communication).

A literature review produced the oxygen uptake rates expressed as grams of oxygen per square metre of bottom area per day listed in Table 3. With estimates of the bottom area and areal oxygen uptake rates, calculations were made of the potential oxygen demand of inundated bottom material during incremental filling periods. A stratification period of 185 days (15 May-16 November) was chosen based upon analysis of the data tabulated in Appendix A; Brooks and Deevey, 1963; and New York State Electric and Gas Corporation, 1974. An initial DO concentration of 12 mg/l at the onset of stratification was used.

Three scenarios were developed based upon three different decay rates during each initial inundation. The purpose was to band the potential

oxygen uptake rates and resulting hypolimnetic DO concentrations that might exist in Dickey Lake during the filling process, if constructed. The initial oxygen uptake rates selected were 3.60, 2.40, and $1.23 \text{ g/m}^2/\text{day}$, which were taken from Stein and Denison, 1966; Edberg and Hofsten, 1973; and McKeown et al., 1968, respectively. The uptake rate of 3.60 $\text{g/m}^2/\text{day}$ was measured in situ for sulfite pulpmill waste in an estuary. This should represent a high rate of uptake due to the continual replenishment of DO and mixing of bottom sediments through tidal flushing.

The rate $2.40 \text{ g/m}^2/\text{day}$ was measured in situ in a eutrophic lake that had newly deposited algal layers on the bottom sediment, which should represent readily oxidizable organic matter similar to what might exist at the time of first filling. The third rate, $1.23 \text{ g/m}^2/\text{day}$, represented the peak oxygen demand measured on benthic deposits of wood origin measured under laboratory conditions. This should represent a low rate. Although DO concentrations were maintained, mixing was minimal. These three decay rates were applied each time a new zone was inundated for each of the four years to provide a range of estimates of the DO demand of inundated bottom material (Figure 5).

During the second year of filling, the previously discussed rates were applied to the newly inundated zone. A new oxygen uptake rate of $0.80 \text{ g/m}^2/\text{day}$ was applied to the previously inundated bottom zone for all cases since it was assumed the readily oxidizable organic matter had exerted its peak demand during the first year of inundation (Figure 5). This rate represents the average benthic demand from deposits of wood origin in the laboratory (McKeown et al., 1968). During the third and

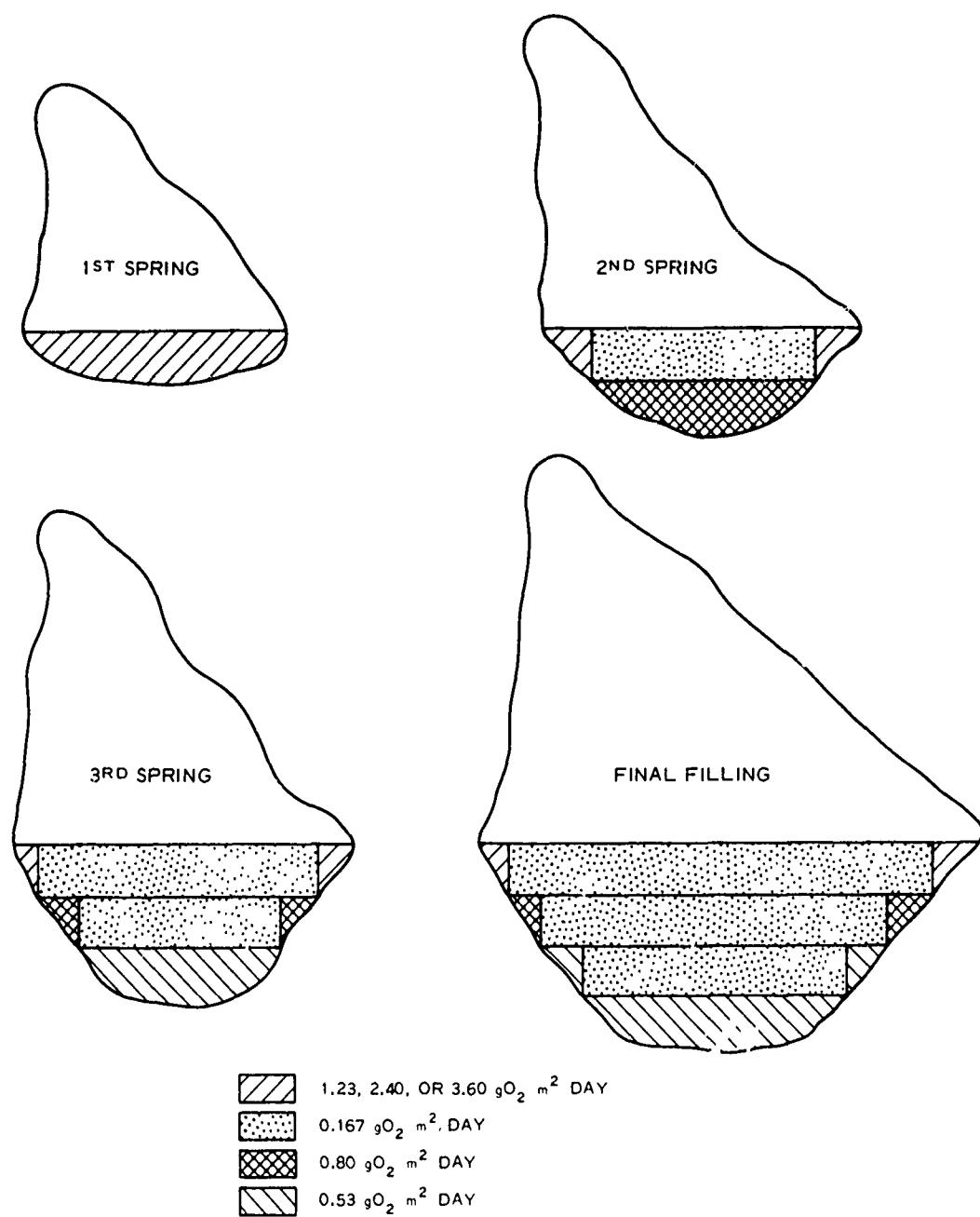


Figure 5. Oxygen uptake rates applied to different zones during incremental filling. Complete hypolimnetic mixing assumed at the end of stratification

fourth years of filling, each of the two previously discussed rates was applied to the next successive zone. The oxygen uptake rate for the zone that had been inundated for two complete years or more was assumed to be $0.53 \text{ g/m}^2/\text{yr}$ (Figure 3). This represents the upper rate used in a DO model of Cayuga Lake (Newbold and Liggett, 1974), and is representative of the rates for lake sediments (Table 3). The rate of 0.53 was the lowest uptake rate used in these calculations.

All of the above rates reflect some oxygen demand from the overlying water as well as the oxygen demand of the bottom matter. The overlying water oxygen demand, however, is generally much less than the bottom demand. To account for the oxygen demand of organic matter dissolved or suspended in the water not directly associated with the bottom, an oxygen uptake rate of $0.167 \text{ g O}_2/\text{m}^2/\text{day}$ was used (Figure 5, stippled area). This rate is the arbitrary upper limit set by Hutchinson (1957) for oligotrophic lakes. Based on the present land use, i.e. forested, and nutrient loading analyses (Cassidy, personal communication), Dickey Lake is expected to be an oligotrophic lake.

The oxygen uptake rates for each zone were used to compute the oxygen demand during the 185-day stratification period. The oxygen remaining or oxygen deficit at the end of the stratification period in each zone was then volume-weighted and averaged over the entire hypolimnion to arrive at an average DO concentration for the hypolimnion.

The results of these three cases are shown in Table 4. Under the highest oxygen uptake rate, the hypolimnion would be anoxic until the end of the third spring of incremental filling. The lower two uptake

rates would result in an aerobic hypolimnion after the second spring of incremental filling. The lowest decay rate would result in a hypolimnion with an average DO of greater than 5 mg/l after the third spring of incremental filling. At the median oxygen uptake rate, an average DO greater than 5 mg/l would not occur in the hypolimnion until the second year after complete filling.

It is not possible to predict absolute values with the above approach, but the calculations do indicate that the hypolimnion will have greater than 5 mg/l of DO by at least the second year of complete filling and possibly earlier.

Coves and Embayments

The Saint John, Little Black, and Big Black Rivers have a total of 64 tributaries that will form major coves in Dickey Lake. These major coves will vary in depth from less than 3 m to over 85 m. In addition, Dickey Lake will have a shoreline development ratio of 8.83, indicative of an extremely irregular shoreline and typical of highly dendritic-shaped lakes. The shoreline development ratio is the ratio of the shoreline length to the length of the circumference of a circle of area equal to that of the lake (Hutchinson, 1957). It is not possible to address each of the major coves expected to be formed in Dickey Lake, let alone the minor coves, based on the present limited data set and limited morphometric and topographic description of Dickey Lake available for this study. Mesoclimate also becomes important in a project as large as Dickey Lake and may be expected to play a significant role in establishing the temperature and

DO characteristics within each cove. With these caveats, it is possible to present general conclusions about those coves that are not hydrodynamically isolated from the main body of the lake.

Those shallow coves that do not stratify during the summer would be expected to be near saturation with DO and somewhat warmer than the in-lake epilimnion. Coves that are deep enough to stratify during the summer but that have a relatively shallow hypolimnion (maximum depth of 30 m or less) can be expected to have lower DO concentrations than the in-lake hypolimnions for two reasons: (a) there is initially less volume of the hypolimnion to supply DO for oxygen uptake by bottom materials, and (b) hypolimnetic temperatures probably will be warmer than in-lake temperatures resulting in higher biological activity. This is illustrated in Figure 2. The DO at depths of 30 m or less dropped as low as 1.7 mg/l. Each minima spike represents the DO concentration near the bottom of one of the shallower study lakes. The maximum temperature recorded at 30 m was about 12°C. Deep coves may be considered as extensions of the main body of the lake and may be expected to exhibit similar DO and temperature regimes.

During the winter, some of the shallower coves may freeze to the bottom. Those coves that do not freeze to the bottom but have shallow water depths may experience low DO concentrations. The deeper coves may have low DO concentrations within the bottom metre but, in general, will probably have higher DO concentrations within the water column.

Discussion

Dickey Lake is predicted to be a dimictic, holomictic reservoir that will freeze over during winter. This is similar to the other Maine and

Canadian lakes (Brooks and Deevey, 1963; Davis et al., 1976; Quebec Service de la qualite des eaux, personal communication). Although Dickey Lake is deep, it is expected to mix completely during the isothermal overturn periods. Brooks and Deevey (1963) state no inland lakes in New England are known to be meromictic. The holomictic assumption is important in satisfying hypolimnetic oxygen deficits at the end of the stratification period.

In general, mixing is expected to be more prevalent in the hypolimnion during stratification in Dickey Lake than in natural lakes. Withdrawal and pumpback operations should result in internal currents within the hypolimnion and could produce additional mixing since the cycling of the pumpback and withdrawal operations is expected to create internal waves and currents. Due to reflection and movement of these currents, the hypolimnion should remain fairly well mixed and distribute DO supplies and demands rather uniformly throughout the volume.

The DO concentrations in deep northeastern lakes rarely decrease below 6 mg/l in the hypolimnion during the summer stratification period. Wright (1969) calculated an average oxygen depletion rate of 1 mg/l/month for Cayuga Lake. A DO value of 12 mg/l at the onset of stratification, therefore, would result in a value of 6 mg/l at the end of the stratification period in Cayuga Lake (Wright, 1969). DO values are generally higher than 6 mg/l in Cayuga Lake, however. Potash and Henson (1975) found that DO concentrations 1 m from the bottom at the end of the summer stratification period in Lake Champlain rarely fall below 65 percent of saturation (about 7.8 mg/l).

DO concentrations in Dickey Lake are expected to remain high in the hypolimnion during the winter stratification period. Before complete surface freezing and snow cover, convective currents may continually mix the lake and replenish any oxygen deficits. After freezing and snow cover, low temperatures will reduce biological and chemical oxidation of organic matter. Deep Canadian lakes that have a typical clinograde oxygen curve during summer stratification do not develop the same type of curve during winter stratification (Ministry of Natural Resources, personal communication). In these lakes, the hypolimnetic DO remains high to within a few metres of the bottom. Within these few bottom metres only, the DO concentration decreases rapidly toward the sediment-water interface (Ministry of Natural Resources, personal communication). DO concentrations at the mud-water interface may range from 0- to 15-percent saturation near the end of winter stratification (Hutchinson, 1957).

Land in the upper Saint John River drainage basin is presently classified as forested with very little agriculture and essentially no urban area. Land-use patterns around many of the other deep northeastern lakes such as Cayuga, Seneca, Champlain, Sebago, etc., include urban, agricultural, open, and forested areas. These lakes, however, retain high hypolimnetic DO concentrations during the summer stratification period. It is expected, therefore, that changes in the land use of the drainage area such as moderate increases in agriculture will have little impact on hypolimnetic DO within the foreseeable future.

Several assumptions were made for analysis of the DO during the filling period. The oxygen uptake rates were assumed to be constant

during the entire stratification period. This probably resulted in an overestimate of the oxygen demand since oxygen uptake rates diminish with decreasing oxygen concentrations (Hargrave, 1969; Edwards and Rolley, 1965). The average oxygen uptake rate for oxidizable organic matter of wood origin was reduced from 0.80 to 0.38 g/m²/day after continual exposure in the laboratory at 20°C (McKeown et al., 1968). It is expected that this decay would occur more slowly at 5 to 7°C, but there would be some gentle mixing in the field that would expose more surface area and replenish the oxygen supply. A reduction in the oxygen uptake rates during successive years of filling is expected and was, therefore, reflected in the analysis.

The stratification period of 185 days or from 15 May to 16 November is consistent with observed data (Appendix A). Stratification dates observed by New York Electric and Gas Corporation (1974) in Cayuga Lake from 1950 to 1972 were as follows:

Year	Date of Permanent Stratification	
	Started	Ended
1950	--*	12 Dec - 1 Jan**
1951	--	13 Nov - 31 Dec**
1967	--	2 Dec
1968	--	10 Dec
1969	22 May	--
1970	21 May	20 Dec
1971	3 May	16 Dec - 21 Dec**
1972	after 10 May	13 Dec

* No data.

** No data between dates given.

The dates given for the end of stratification in Cayuga Lake represented isothermal conditions. However, DO is transferred throughout the hypolimnion before the lake is isothermal. An initial DO concentration of 12 mg/l at the onset of stratification was selected after an analysis of the data on deep impoundments. Wright (1969) also indicated the hypolimnion of Cayuga entered the stratification period in late May or early June with a DO concentration of about 12 mg/l. This represents about 95-percent saturation at the average hypolimnion temperature.

The assumption of complete hypolimnetic mixing is probably not completely valid although intermittent mixing certainly occurs (Hutchinson, 1957). This assumption of complete hypolimnetic mixing was required to calculate the demand on a volume basis by dividing by the volume of the hypolimnion. Water movement in the hypolimnion is expected as a result of internal waves created by generation and pumpback activities. In addition, density currents can be created through the decay of organic matter. The release of dissolved organics into the overlying water strata is sufficient to modify the density of this water and create a current as water moves to reduce the density gradient (Hutchinson, 1957).

Although the oxygen deficit is substantial after the first year of the filling process, this demand may be satisfied through holomixis. A percentage of this deficit will also be satisfied by mixing with the epilimnion. Based on personal communication with Matthew Scott (Maine Department of Environmental Protection), the graph of time for complete ice out for Maine lakes (Brooks and Deevey, 1963), communication with the Ministry of Natural Resources (Quebec province), and analysis of data in

Appendix A, Dickey Lake was assumed to mix for 10 days in the spring prior to stratification and 15 days in the fall prior to freezing. Although lakes with small surface areas may circulate only a few days before stratifying, large lakes often circulate for a period of weeks before stratification occurs (Wetzel, 1975). In the stated time periods, sufficient mixing should occur to satisfy the oxygen demand. With a wind velocity of 5 m/sec over a lake with the surface area of Dickey Lake, vertical velocities in Langmuir convective cells may move at about 4 cm/sec or 3456 m/day (Scott et al., 1969). Theoretically, this would be sufficient to turn Dickey Lake over approximately 17 times a day. During the fall, convective currents would be quite strong because of cooling and will also be important in transporting oxygen from the surface to the bottom. If the entire lake became anoxic at overturn, the flux of oxygen across the surface would be $12.2 \text{ g/m}^3/\text{sec}$ or $1054 \text{ kg/m}^3/\text{day}$ based on an analysis using the work of Emerson (1975). The flux would diminish as the surface DO concentration approaches that of the air-water interface, but it is clear a substantial quantity of oxygen could be transported to the bottom.

While holomixis was assumed, biogenic meromixis may not be excluded. Dworshak Reservoir, in Idaho, became meromictic during and just following the period of filling (Falter et al., 1973, 1974). This may occur during the filling period in Dickey Lake since the project will not be operated with pumpback during the filling period. It should be noted, however, that Dworshak is nearly twice as deep as the proposed Dickey Lake and has less surface area. It is expected that Dworshak Reservoir would take much longer to completely mix than Dickey Lake and this may have

contributed to the meromictic condition. Once pumpback operations begin, it is expected that any chemical stratification that might be established would be destroyed and a holomictic state would be established.

It is expected that the stabilization period for Dickey Lake will be approximately 6 to 9 yr. This stabilization period is typical of many Corps of Engineers impoundments, and depending upon the parameter, is within the duration of the stabilization period found in several other uncleared reservoirs (Table 5). The necessity of reservoir clearing in cold climates is questionable. Campbell et al. (1976) found no significant difference in nutrient or metal releases between stripped and unstripped soils at 1°C. This was not true at 25°C, however. At the higher temperature, soil stripping significantly reduced nutrient and metal releases.

The data presented in Figure 3 may be used to speculate on cove conditions, but it should be used with caution. These data reflect conditions within an entire lake that may respond to meteorological changes very differently than a cove. Covés may also be influenced by the main body of the lake. The generalized statements are also confounded by the proposed annual average drawdown of the pool elevation by 6.1 m. This would expose the bottom in some of the covés, resulting in increased oxidation and mineralization of the organic matter. This might promote algal production upon reflooding by releasing nutrients into the overlying waters. The extent of these releases cannot be determined from existing data.

Conclusions

Based on a comparison of DO profiles in 25 lakes that are similar in geographic location to the proposed Dickey Lake impoundment and on a limited literature review, the following conclusions are considered warranted:

- a. Dickey Lake is predicted to be a dimictic, holomictic lake that will freeze over during the winter.
- b. The DO in Dickey Lake in steady state after stabilization is expected to be near saturation in the epilimnion and at or above 6 mg/l in the hypolimnion at the end of the summer stratification period.
- c. Dickey Lake is expected to have 5 mg/l of DO in the hypolimnion by the second year after complete filling and possibly earlier. During the filling period, the reservoir may become meromictic, but it is expected to be holomictic after pumpback operations begin. The reservoir is expected to stabilize in 6 to 9 yr after filling.
- d. The DO may be lower in the coves and embayments depending upon mesoclimatological events. Dissolved oxygen contents approaching 2 mg/l may be expected at isolated times in the hypolimnion of the shallower coves.

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Table 1
Morphometry of Dickey Lake and 25 Study Lakes

No.*	Lake Name	Lake Type	Drainage Area, km ²	Maximum Depth, m	Mean Depth, m	Surface Area, km ²	Volume m ³	Loading, g/m ² /yr		
								Nitrogen	Total Phosphorus**	Total
1	Dickey Lake	Power Reservoir	1,058	99.1	23.8	348.1	9.5x10 ⁹	--	--	0.19
2	Long Lake	Natural	210	49.7	16.2	24.3	3.9x10 ⁸	--	--	0.12
3	Eagle Lake	Natural	1,968	42.7	13.7	22.6	3.1x10 ⁸	--	--	0.76
4	Cold Stream Pond	Natural	56.6	31.7	13	14.7	1.8x10 ⁸	--	--	0.017
5	Emoden Pond	Natural	54.6	50.3	15.7	6.3	1.0x10 ⁸	--	--	0.03
6	Moosehead Lake	Natural; added dam for power	2,977	75	16.5	303.1	5.0x10 ⁹	--	--	0.08
7	Sebago Lake	Natural	1,048	96.3	34.1	116.4	3.98x10 ⁹	--	--	0.08
8	Rangefley Lake	Natural	240	45.4	14.8	24.3	3.6x10 ⁸	--	--	0.09
9	Lake Mégaantic	Natural	751	75	28.8	26.42	7.9x10 ⁸	--	--	0.02 mg/l
10	Lake St. Francois	Natural	1,157	40.2	15.6	47.14	7.1x10 ⁸	--	--	0.02-0.03 mg/l
11	Lake Aylmer	Natural; dam for power	1,682	36.3	8.6	29.53	2.6x10 ⁸	--	--	<0.02 mg/l
12	Lake Nicolet	Natural	9	41.4	17.3	4.01	7.2x10 ⁷	--	--	0.02 mg/l
13	Lake Champlain	Natural	20,057	122	22.4	1,139.5	25.6x10 ⁹	--	--	0.81
14	Lake Seize Iles	Natural	--	50	--	3.65	--	--	--	--
15	Lake Montagne Tremblante	Natural	--	100	--	9.45	--	--	--	--
16	Lake Labelle	Natural	--	70	--	7.38	--	--	--	--
17	Lake Trois Montagne	Natural	--	50	--	3.34	--	--	--	--
18	Otisco Lake	Natural	88	20.1	10.2	7.6	7.8x10 ⁷	--	--	0.34 SP
19	Skaneateles Lake	Natural	189	90.5	43.5	35.9	1.6x10 ⁹	--	--	0.16 SP
20	Owasco Lake	Natural	539	54.0	29.3	26.7	7.8x10 ⁸	--	--	0.56 SP
21	Cavugia Lake	Natural	2,106	132.6	54.5	172.1	9.4x10 ⁹	--	--	0.49
22	Seneca Lake	Natural	1,831	198.4	88.6	175.4	15.5x10 ⁹	--	--	0.30 SP
23	Kesika Lake	Natural	484	55.8	30.5	47.0	1.4x10 ⁹	--	--	0.33 SP
24	Honeoye Lake	Natural	95	9.2	4.9	7.0	3.5x10 ⁷	--	--	0.30 SP
25	Canadice Lake	Natural	31	25.4	16.4	2.6	4.3x10 ⁷	--	--	0.22 SP
26	Hemlock Lake	Natural	111	27.5	13.6	7.2	1.0x10 ⁸	--	--	0.29 SP

*Numbers correspond to similar numbers in Figure 1.

**SP indicates soluble phosphorus determination.

Table 2
Study Lakes and Data Sources

Lake	Data Source
Dickey	NED
Long	Davis et al., 1976
Eagle	Cowir ; and Scott, 1975, 1976
Cold Stream Pond	Davis et al., 1976
Embden Pond	Davis et al., 1976
Moosehead	Cooper and Fuller, 1945; NED, unpublished data
Sebago	Cooper, 1939
Rangeley	Davis et al., 1976
Mégantic	Québéc Service de la qualité des eaux, 1976b
Saint Francois	Québéc Service de la qualité des eaux, unpublished data
Aylmer	Québéc Service de la qualité des eaux, 1976a
Nicolet	Québéc Service de la qualité des eaux, 1976c
Champlain	Henson et al., 1966; Potash and Henson, 1975
Seize Iles	Québéc Service de la qualités des eaux, unpublished data
Montagne Tremblante	Québéc Service de la qualités des eaux, unpublished data
Labelle	Québéc Service de la qualités des eaux, unpublished data
Trois Montagne	Québéc Service de la qualités des eaux, unpublished data
Otisco	Oglesby unpublished data
Skaneateles	Oglesby unpublished data
Owasco	Oglesby unpublished data
Cayuga	Henson et al., 1961; Oglesby and Allee, 1969; Oglesby unpublished data
Seneca	Oglesby unpublished data
Keuka	Oglesby unpublished data
Honeoye	Oglesby unpublished data
Canadice	Oglesby unpublished data
Hemlock	Oglesby unpublished data

Table 3
Oxygen Uptake Rates from Literature

Lake	Oxygen Uptake Rate g/m ² /day	Temperature °C	Remarks	Data Source
Erken	0.43	4	In situ	Edberg and Hofsten, 1973
Norrviiken 1	1.80	5	Newly deposited algal layers.	Edberg and Hofsten, 1973
2	2.40	7		
Rivers Hiz & Ivel	0.96-2.40	10	--	Edwards and Rolley, 1965
Marion	0.109	4	Computed from regression equation based on O ₂ consumption vs temperature	Hargrave, 1969
	0.140	5		
	0.173	6		
Punchbowl	0.165	11	Measured in situ in columns	Hayes and MacAulay, 1959
Black Brook	0.212	11		
Copper	0.180	11		
Grand	0.300	11		
--	0.96-1.92	5	Computed from regression equation	McDonnell and Hall, 1969
--	0.20-0.80	20	Benthic demand from deposits of wood origin (laboratory)	McKeown et al., 1968
--	0.18-0.38	20	Same as above after 30-50 days exposure	McKeown et al., 1968
Castle	0.46-1.20	15	Laboratory study of lake sediment	Neame, 1975
Cayuga	0.32-0.53	4	Values used in mathematical model of Cayuga	Newbold and Liggett, 1974
Port Angeles Harbor	3.60	10.9	Estuary. In situ in pulpmill sulfite wastes	Stein and Denison, 1966

Table 4

Potential Hypolimnion Oxygen Values
during Incremental Filling

<u>Time of Filling</u>	<u>Elevation m</u>	Decay Rate, $\text{g/m}^2/\text{day}$ - Avg Hypolimnion		
		<u>1.23</u>	<u>2.40</u>	<u>3.60</u>
1st spring	239.3	-0.8*	-25.0	-37.4
2nd spring	258.2	4.2	0.7	-2.8
3rd spring	269.1	5.3	3.1	0.8
Final spring	277.4	5.1	3.1	1.1
2nd full year	277.4	6.2	6.2	6.2

* Negative values represent an unsatisfied oxygen deficit at the end of the stratification period.

Table 5

Duration of Stabilization Period in Uncleared
Reservoirs (after Campbell et al., 1976)

<u>Region</u>	<u>Parameter</u>	<u>Duration, yr</u>	<u>Reference</u>
Cold temperate	Biological productivity	25-30	Lowe-McConnell, 1971
United States	Color, Fe, CO ₂	10-15	Fair et al., 1966
New England	Color, plankton	8-10	Whipple, 1914
Connecticut	Color, odor, organic nitrogen, biota	3-10 (mean of 6) 1-38 (mean of 13)	Stearns, 1917
Connecticut	Color	3-10 (mean of 6)	Saville, 1925
New Jersey	Color, Fe, CO ₂	7	Purcell, 1939
Russia >50°N	Biological productivity	25-30	Lapitsky, 1966
Russia <50°N	Biological productivity	6-10	Lapitsky, 1966
Russia, Ural Mountains	Physicochemical, algae, bacteria	7	Miterev and Belova, 1957
Warm temperate	Biological productivity	10-15	Lowe-McConnell, 1971
Tropical	Biological productivity	10	Lowe-McConnell, 1971

APPENDIX A
TEMPERATURE AND DO DATA
FOR 25 STUDY LAKES

A 1

Long Lake
Maine

Depth (m)	6/29/70		8/17/70		11/10/70		4/19/71		6/21/71		8/24/71	
	Temp*	DO**	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
0	9.1	10.2	13.1	10.1	4.3	10.2	0.0	13.2	10.9	11.3	11.0	8.8
5	9.0	9.0	12.8	8.5	4.3	10.2	0.7	12.5	9.0	11.5	10.5	6.1
10	7.6	7.0	8.0	6.1	4.3	10.2	1.0	11.8	6.5	11.6	10.5	4.5
15	6.8	8.0	4.9	5.0	4.3	10.2	1.3	11.1	6.0	10.6	7.0	3.1
20	5.7	10.0	4.9	5.3	4.3	10.2	1.9	9.1	5.1	10.0	6.0	2.9
25	--	--	4.2	6.0	4.3	10.2	2.1	8.5	5.0	9.1	5.8	3.0
30	--	--	--	--	--	--	--	--	--	--	5.0	3.0
A2	11/16/71		4/11/72		6/27/72		8/28/72		11/13/72		3/26/73	
	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
0	3.5	11.0	0.0	13.0	11.0	9.5	11.6	10.0	3.0	11.1	0.0	13.0
5	3.5	11.0	1.0	13.6	10.5	9.8	11.6	10.0	3.0	11.1	0.3	12.0
10	3.5	11.0	1.2	12.0	6.0	10.5	10.0	10.0	3.0	11.0	0.7	11.1
15	3.5	11.0	1.2	11.0	4.1	10.1	4.2	7.5	3.0	11.1	1.0	11.1
20	3.5	11.0	1.2	10.5	3.9	10.1	4.1	7.1	3.0	11.0	1.3	10.8
25	3.5	11.0	1.2	9.9	3.4	10.0	4.0	7.0	3.0	11.0	1.7	9.9
30	--	--	1.5	9.2	3.3	10.0	4.0	7.0	3.0	11.0	1.9	9.0
35	--	--	1.9	7.5	3.0	10.0	4.0	6.5	3.0	11.0	2.0	9.1
40	--	--	--	--	3.0	8.5	4.0	6.3	3.0	11.0	2.1	7.9
45	--	--	--	--	--	--	--	6.2	3.0	11.0	2.2	3.9

* Temperatures are in °C.

** DO is measured in mg/l

Eagle Lake
Maine

Station 1				Station 2				Station 3			
9/9/75		9/9/75		9/9/75		9/9/75		9/8/75		9/8/75	
<u>Depth (m)</u>	<u>Temp*</u>	<u>DO**</u>	<u>Depth (m)</u>	<u>Temp</u>	<u>DO</u>	<u>Depth (m)</u>	<u>Temp</u>	<u>Depth (m)</u>	<u>Temp</u>	<u>DO</u>	<u>Depth (m)</u>
0.6	16.4	10.0	0.6	16.8	10.2	0.6	17.0	9.9			
8.0	16.4	9.6	12.0	16.8	9.9	8.0	16.6	9.5			
14.0	7.5	7.8	20.0	8.2	8.1	15.0	9.0	6.3			
35.0	5.8	6.5	27.0	6.2	6.8	22.0	8.0	4.8			

* All temperatures are in °C.

** DO is measured in mg/l.

Cold Stream Pond South Basin Maine

Depth (m)	6/30/70		8/18/70		11/11/70		4/20/71		6/22/71		8/24/71	
	Temp*	D0**	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
0	10.7	9.0	13.8	8.8	5.5	10.5	0.8	13.0	12.0	10.0	12.9	9.1
5	10.7	8.9	13.8	8.0	5.5	10.5	1.8	13.0	11.1	11.0	12.7	7.0
10	6.1	10.0	8.0	10.0	5.5	10.5	1.2	12.9	7.0	12.0	9.0	6.5
15	5.1	10.0	5.4	9.9	5.5	10.5	1.7	12.0	4.5	12.0	5.0	5.6
20	5.0	10.9	5.1	9.2	5.5	10.5	2.0	10.4	4.2	12.0	4.3	5.3
25	5.0	10.7	5.1	9.0	5.5	10.5	2.1	8.8	4.2	12.0	4.3	5.0
30	--	--	--	--	--	--	--	--	4.0	11.9	4.0	4.2
	11/17/71		4/12/72		6/28/72		8/29/72		11/14/72		3/27/73	
Depth (m)	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
0	3.6	11.9	0.5	14.2	12.8	9.1	12.0	9.1	4.1	13.0	0.0	12.1
5	3.6	11.9	1.0	13.2	10.0	9.5	11.5	9.1	4.1	14.0	1.0	12.3
10	3.6	11.9	1.5	13.2	7.0	10.5	9.0	9.3	4.1	13.2	1.0	12.5
15	3.6	11.9	1.8	13.0	5.0	11.2	5.4	9.8	4.1	13.2	1.0	12.4
20	3.6	11.9	2.0	11.1	5.0	11.2	4.9	9.2	4.1	13.0	1.0	10.9
25	3.6	11.9	2.1	9.3	5.0	11.1	4.9	9.1	4.1	12.8	1.3	8.1
30	3.6	--	2.5	4.8	4.9	11.0	4.9	9.1	4.4	12.6	1.7	5.0

- * All temperatures are in $^{\circ}\text{C}$.

** DO is measured in mg/l.

Cold Stream Pond North Basin
Maine

Depth (m)	4/12/72		6/28/72		6/29/72		11/14/72		3/27/73	
	Temp*	DO**	Temp	DO	Temp	DO	Temp	DO	Temp	DO
0	1.0	13.1	13.4	11.8	13.5	8.1	2.1	13.3	0.7	13.0
5	1.8	12.0	11.0	11.8	12.2	8.0	2.2	13.6	0.8	10.7
10	2.0	9.1	5.6	11.8	6.4	4.0	2.4	13.9	1.2	8.3
15	2.0	6.5	5.0	11.9	5.7	3.9	2.6	14.0	2.1	5.8

* All temperatures are in °C.

** DO is measured in mg/l.

Moosehead Lake
Maine

Depth (m)	Station W1		Station W2		Station W3		Station W4		Station W6		Station W7	
	6/5/44 <u>Temp</u>	DO**	6/6/44 <u>Temp</u>	DO	6/6/44 <u>Temp</u>	DO	6/6/44 <u>Temp</u>	DO	6/11/44 <u>Temp</u>	DO	6/13/44 <u>Temp</u>	DO
0	20.4	9.4	20.5	9.2	20.3	9.3	19.7	9.5	19.2	9.6	19.0	9.0
3	19.4	--	19.8	--	20.2	--	19.4	--	18.6	--	19.0	--
6	16.1	10.0	14.6	9.5	14.7	9.4	14.5	9.9	14.4	10.0	18.5	9.0
9	14.2	10.0	14.1	9.6	13.6	10.0	12.6	10.3	11.8	10.5	16.5	8.4
12	12.8	--	13.5	--	13.0	--	11.4	10.3	11.2	--	15.0	--
15	11.8	10.4	12.3	9.8	11.7	9.6	10.3	10.6	10.5	10.9	11.0	8.3
18	11.0	--	11.7	--	11.2	--	9.7	--	9.5	--	10.1	--
A6	21	10.6	10.5	11.1	9.8	11.0	10.0	8.8	10.2	9.3	11.1	8.7
24	10.4	--	10.9	--	--	--	8.0	--	8.6	--	8.2	--
27	10.1	--	10.6	--	--	--	7.5	--	7.9	--	7.8	--
30	9.6	--	10.3	9.7	--	--	6.9	10.7	7.6	11.4	7.4	9.7
33	8.8	--	--	--	--	--	6.2	--	--	--	7.3	9.1
36	8.2	10.1	--	--	--	--	6.0	11.1	7.1	--	--	--
39	7.9	--	--	--	--	--	5.9	--	--	--	--	--
42	7.7	10.5	--	--	--	--	5.7	11.1	6.8	11.6	--	--
45	--	--	--	--	--	--	5.6	10.9	--	--	--	--

* All temperatures are in °C.

** DO is measured in mg/l.

Moosehead Lake (Continued)

Depth (m)	Station W1		Station W2		Station W3		Station W4		Station W6		Station W7	
	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
48	--	--	--	--	--	--	5.6	--	6.5	--	--	--
51	--	--	--	--	--	--	5.5	--	--	--	--	--
54	--	--	--	--	--	--	--	--	6.4	11.5	--	--
57	--	--	--	--	--	--	--	--	--	--	--	--
60	--	--	--	--	--	--	--	--	6.3	--	--	--
63	--	--	--	--	--	--	--	--	6.3	11.6	--	--
Depth (m)	Station W8		Station W9		Station W10		Station W11		Station W12		Station W13	
	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
	8/2/44		8/7/44		8/7/44		8/8/44		8/8/44		8/10/44	
0	22.0	9.0	21.3	8.7	22.6	7.9	20.8	8.7	23.0	8.7	22.5	8.1
3	19.2	--	21.0	--	21.2	--	20.4	--	21.8	--	22.2	--
6	18.8	--	20.7	8.7	21.0	8.5	20.1	8.6	21.5	8.6	19.8	7.6
9	18.4	9.1	16.7	8.6	17.9	8.5	19.6	8.4	19.2	8.8	--	--
12	13.6	9.4	13.9	--	15.8	--	17.7	--	13.3	--	--	--
15	11.6	9.6	13.0	8.9	13.3	8.8	12.4	9.0	11.1	9.7	--	--
18	10.7	--	12.1	--	12.0	--	9.9	--	9.9	--	--	--

Moosehead Lake (Continued)

Depth (m)	Station W8		Station W9		Station W10		Station W11		Station W12		Station W13	
	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
21	9.4	10.1	11.6	8.9	11.7	9.0	9.0	9.6	9.6	10.0	--	--
24	9.1	--	11.1	--	11.5	--	8.6	--	9.0	--	--	--
27	--	--	10.7	--	11.4	8.8	8.2	--	8.4	--	--	--
30	8.2	10.2	10.4	9.4	11.3	8.8	8.0	10.0	8.1	10.2	--	--
33	--	--	9.8	--	--	--	7.8	--	7.9	--	--	--
36	7.3	10.6	9.4	--	--	--	7.4	--	7.8	--	--	--
39	--	--	8.9	9.3	--	--	7.2	10.6	7.8	10.3	--	--
42	6.5	10.7	8.8	--	--	--	7.0	--	7.7	10.1	--	--
45	--	--	8.6	9.1	--	--	7.0	--	--	--	--	--
48	6.6	--	--	--	--	--	--	--	--	--	--	--
51	5.8	--	--	--	--	--	6.9	10.4	--	--	--	--
54	--	--	--	--	--	--	--	--	--	--	--	--
57	--	--	--	--	--	--	6.8	--	--	--	--	--
60	--	--	--	--	--	--	6.7	10.6	--	--	--	--

Moosehead Lake (Concluded)

Depth (m)	Station W14		Station W15		Station W16		Station 1		Station 2		Station 6	
	8/10/44		8/11/44		8/16/44		8/24/76		8/24/76		8/25/76	
	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
0	22.6	8.4	21.8	8.6	22.1	--	21.2	8.4	22.7	9.3	20.3	8.0
3	21.7	--	21.7	--	22.1	--	20.8	10.7	21.6	11.1	19.8	7.9
6	20.3	8.4	21.1	8.6	21.0	--	19.8	12.5	21.3	12.3	19.5	7.9
9	17.8	8.1	20.4	8.5	18.5	--	13.3	13.3	20.6	13.1	19.1	7.8
12	15.9	--	15.4	--	16.8	--	11.1	13.1	9.4	11.9	17.4	7.6
15	12.6	8.3	13.7	8.7	11.7	--	9.0	12.7	8.7	11.4	11.8	7.2
18	11.9	--	12.6	--	10.5	--	--	--	8.2	11.1	10.4	7.5
21	11.6	7.9	11.1	9.2	9.7	--	--	--	7.8	10.7	10.1	7.5
24	11.6	--	11.1	--	8.9	--	--	--	7.4	10.3	9.8	7.5
27	11.6	8.4	11.1	--	8.9	--	--	--	6.9	9.9	9.7	7.3
30	--	--	10.8	9.3	8.3	--	--	--	6.9	9.5	9.6	7.2
33	--	--	10.6	--	8.0	--	--	--	--	--	--	--
36	--	--	10.5	9.3	7.9	--	--	--	--	--	--	--
39	--	--	10.4	--	7.5	--	--	--	--	--	--	--
42	--	--	--	--	7.2	--	--	--	--	--	--	--
45	--	--	--	--	7.1	--	--	--	6.9	--	--	--

A9

Emden Pond
Maine

Depth (m)	6/17/70		8/5/70		9/7/70		11/1/70		4/9/71		5/15/71	
	Temp*	DO**	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
0	12.1	9.1	14.0	8.9	10.9	9.2	6.0	10.2	--	12.9	3.1	11.9
5	8.9	10.9	14.0	8.2	10.9	9.0	6.0	10.2	1.6	11.1	3.1	11.9
10	4.3	11.0	5.9	12.0	8.0	9.0	6.0	9.0	1.9	11.0	3.1	11.9
15	4.0	11.0	4.1	10.5	4.5	8.8	6.0	5.5	2.0	11.0	3.1	11.9
20	3.5	10.9	3.5	11.2	4.0	8.5	4.5	3.0	2.0	11.0	3.0	11.9
25	3.2	11.6	3.1	10.9	3.7	8.2	4.0	2.9	2.0	10.9	2.9	11.9
30	3.0	10.5	3.0	10.8	3.4	8.1	3.9	2.5	2.0	10.8	2.9	11.9
35	--	--	--	9.5	--	8.2	3.9	2.1	2.1	10.3	2.9	11.9
40	--	--	--	8.3	--	8.3	3.9	2.9	2.1	9.0	2.8	11.9
45	--	--	--	7.5	--	8.4	3.9	3.0	2.1	7.5	2.8	12.0
50	--	--	--	--	--	8.5	3.9	--	2.1	--	2.7	12.1
A10												
Depth (m)	6/30/71		8/19/71		10/2/71		11/28/71		3/13/72		5/15/72	
Depth (m)	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
0	13.0	8.8	13.1	7.9	10.0	9.5	3.1	12.1	--	15.1	2.9	13.0
5	11.5	9.0	13.1	7.3	10.0	9.5	3.1	12.1	1.0	13.1	2.9	12.0
10	5.0	10.1	6.0	9.9	8.0	10.1	3.1	12.1	1.1	12.9	2.9	12.0
15	4.3	10.1	4.5	10.2	5.1	9.9	3.1	12.1	1.2	12.1	2.2	11.9

* All temperatures are measured in °C.

** DO is measured in mg/l.

Emden Pond (Continued)

Depth (m)	6/30/71		8/19/71		10/2/71		11/28/71		3/13/72		5/15/72	
	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
20	3.9	10.2	4.0	10.9	4.0	9.8	3.1	12.0	1.2	12.0	2.1	11.9
25	3.8	10.2	3.9	10.8	3.9	9.7	3.1	11.9	1.3	12.0	2.1	11.9
30	3.7	10.2	3.9	10.5	3.8	9.3	3.1	11.3	1.5	11.9	2.1	11.9
35	3.7	10.2	3.9	10.3	3.8	9.1	3.1	11.0	1.7	11.2	2.1	11.9
40	3.6	10.2	3.9	10.1	3.8	9.0	3.1	9.5	1.9	9.3	2.1	11.9
45	3.5	10.0	3.9	9.8	3.8	--	3.1	--	2.0	5.2	2.1	11.9
50	3.5	9.0	--	--	--	--	--	--	--	--	2.1	--
<hr/>												
Depth (m)	6/28/72		8/11/72		9/15/72		11/19/72		3/23/73		5/2/73	
	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
0	12.9	9.5	12.5	8.0	10.0	8.9	3.1	11.5	--	13.9	3.8	11.0
5	11.0	9.5	12.0	8.0	10.0	8.9	3.1	11.0	1.5	12.0	3.0	11.0
10	4.0	10.8	4.9	9.9	5.5	10.0	3.1	11.0	1.5	12.0	2.9	11.1
15	3.7	10.9	4.5	10.8	4.0	10.1	3.1	11.0	1.5	12.0	2.8	11.1
20	3.1	10.9	4.2	10.9	3.2	10.8	3.1	11.0	1.5	11.5	2.8	11.0
25	3.0	10.9	4.0	10.9	3.0	10.9	3.1	11.0	1.5	11.0	2.8	11.0
30	3.0	10.9	4.0	10.8	3.0	10.9	3.1	11.0	1.5	10.9	2.8	11.1
35	3.0	10.9	4.0	10.5	3.0	10.9	3.1	11.0	1.5	10.0	2.7	11.2

All

Emden Pond (Concluded)

Depth (m)	6/28/72		8/11/72		9/15/72		11/19/72		3/23/73		5/2/73	
	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
40	3.0	10.9	4.0	16.5	3.0	10.9	3.1	10.9	1.7	8.9	2.7	11.3
45	3.0	10.9	4.0	10.5	3.0	10.3	3.1	--	2.0	3.6	2.6	11.2
50	3.0	10.9	4.0	9.5	3.0	--	3.1	--	2.0	--	2.5	11.0

Rangeley Lake
Maine

Depth (m)	8/24/70		11/4/70		4/29/71		6/23/71		9/2/71		11/11/71	
	Temp*	DO**	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
0	10.9	8.4	6.0	10.2	0.8	14.0	11.1	9.0	9.9	9.0	5.0	11.0
5	10.9	8.4	6.0	10.1	0.9	13.0	7.2	10.0	9.7	9.0	5.0	11.0
10	10.0	8.4	6.0	10.0	1.0	11.8	6.0	10.6	9.7	9.0	5.0	11.0
15	8.3	8.5	6.0	9.8	1.2	11.1	4.1	10.0	6.6	8.5	5.0	11.0
20	4.5	8.2	6.0	9.6	1.7	10.5	4.0	10.6	5.3	8.0	5.0	11.0
25	4.5	8.1	6.0	9.5	1.8	9.9	3.9	10.6	5.0	8.0	5.0	11.0
30	3.9	7.6	6.0	9.3	1.9	8.9	3.8	10.6	4.5	8.0	5.0	11.0
35	3.9	7.0	5.6	7.5	2.0	6.3	3.5	10.6	4.2	8.0	5.0	11.0
40	3.9	5.9	5.0	6.0	2.1	4.2	3.2	10.5	4.0	8.0	4.9	11.0
45	--	--	--	--	--	--	3.2	10.4	4.0	7.7	4.2	11.1

Depth (m)	4/13/72		6/21/72		9/1/72		11/21/72		3/29/73		5/14/73	
	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
0	0.0	15.0	9.6	10.0	12.1	9.1	3.0	11.8	0.8	12.0	3.0	12.0
5	0.9	13.5	8.1	10.5	11.7	9.5	3.0	11.9	0.9	12.1	3.0	12.0
10	0.9	13.0	5.0	11.0	7.0	9.3	3.0	11.9	0.9	12.1	3.0	12.0
15	1.0	13.0	4.2	11.0	5.6	9.2	3.0	11.9	0.7	11.7	3.0	12.0
20	1.0	12.9	3.3	11.0	4.1	9.3	3.0	11.9	1.0	11.0	3.0	12.0
25	1.1	12.0	3.2	11.0	4.1	9.5	3.0	11.9	1.0	10.8	3.0	12.0
30	1.3	10.8	3.0	11.0	4.0	9.6	3.0	11.9	1.0	10.1	3.0	12.0
35	1.3	9.7	2.0	11.0	3.9	9.6	3.0	11.9	1.2	8.1	3.0	12.0
40	1.5	5.4	3.0	11.0	3.9	9.3	3.0	11.9	1.7	3.0	3.0	12.0
45	2.0	4.0	3.0	11.0	3.7	9.1	--	11.9	2.0	1.7	3.0	11.9

* Temperatures are measured in °C.
** DO is measured in mg/l.

Sebago Lake
Maine

Depth (m)	9/3/70		4/1/71		9/8/71		3/20/72		9/12/72		3/14/73	
	Temp*	DO**	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
0	11.1	9.0	1.0	13.8	12.1	9.0	0.0	13.0	11.8	9.0	6.8	13.1
5	11.0	9.6	1.0	14.0	12.0	9.0	0.7	12.9	11.0	9.0	0.8	12.8
10	9.0	9.9	1.0	14.1	9.2	9.5	0.9	12.8	10.5	9.0	0.9	12.2
15	4.8	10.2	1.0	14.4	6.0	10.0	1.0	12.3	6.0	10.0	1.2	12.2
20	4.8	10.5	1.2	14.4	4.7	10.0	1.1	12.1	4.5	10.9	1.5	12.5
25	4.7	11.0	.5	14.2	4.7	10.1	1.1	12.0	4.0	11.2	2.0	13.0
30	--	11.2	1.8	14.1	--	--	1.2	11.9	3.3	11.3	2.1	13.1
<hr/>												
Station 1		Station 2		Station 3		Station 4		Station 5		Station 6		
8/4/38		8/8/38		8/9/38		8/9/38		8/5/38		8/4/38		
Depth (m)	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
0	27.2	8.9	25.6	9.0	25.6	8.7	25.6	8.9	26.7	9.1	26.1	9.2
6	25.0	--	25.0	9.3	22.1	--	25.6	--	22.4	--	24.7	--
9	17.9	9.2	15.1	--	--	--	24.4	9.2	20.9	9.5	17.1	--
12	10.0	11.5	11.6	11.3	11.1	11.3	11.8	11.2	12.3	11.1	9.2	11.3
15	8.4	11.8	9.1	--	--	--	--	--	9.6	--	8.8	--
18	7.9	11.9	8.4	--	8.4	--	8.6	--	8.5	11.5	8.4	--
21	7.5	12.0	7.6	--	--	--	--	--	8.3	--	8.1	11.7

* All temperatures are in °C.

** DO is measured in mg/l.

Sebago Lake (Concluded)

Depth (m)	Station 1 8/4/38		Station 2 8/8/38		Station 3 8/9/38		Station 4 8/9/38		Station 5 8/5/38		Station 6 8/4/38	
	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
24	--	--	7.3	12.2	6.7	12.1	7.3	12.2	8.0	11.7	7.9	11.7
27	--	--	6.9	--	--	--	6.8	--	7.9	--	--	--
30	--	--	6.6	12.4	6.0	--	6.6	12.2	7.8	11.7	--	--
33	--	--	--	--	5.9	--	--	--	7.7	--	--	--
36	--	--	--	--	5.8	--	--	--	7.6	11.3	--	--
39	--	--	--	--	5.8	12.3	--	--	7.5	11.5	--	--
42	--	--	--	--	--	--	--	--	7.4	11.4	--	--
45	--	--	5.6	12.8	--	--	--	--	--	--	--	--
60	--	--	5.4	12.8	--	--	--	--	--	--	--	--
75	--	--	5.1	--	--	--	--	--	--	--	--	--
84	--	--	--	--	5.0	12.7	--	--	--	--	--	--
87	--	--	--	--	5.0	12.7	--	--	--	--	--	--
90	--	--	--	--	5.0	12.7	--	--	--	--	--	--

Lake Nicolet
Québec

Depth (m)	Station 2N3E				Station 1N2E			
	5/1/73		6/13/73		5/1/73		6/13/73	
	Temp	DO**	Temp	DO	Temp	DO	Temp	DO
0	3.7	13.3	17.9	9.0	22.8	10.0	--	13.1
3	3.7	13.3	16.0	9.8	22.2	10.0	3.8	13.1
6	3.7	13.3	13.2	10.8	21.0	10.1	3.8	13.1
9	3.7	13.3	10.0	11.5	13.0	11.5	3.8	13.1
12	3.7	13.3	8.0	12.0	8.8	11.9	3.8	13.1
15	3.7	13.8	7.3	12.0	7.9	11.7	3.8	13.1
18	3.7	13.8	6.9	12.0	7.8	11.5	3.8	13.1
21	3.7	13.9	6.5	11.9	7.3	11.5	3.8	13.1
24	3.7	13.9	6.5	11.8	7.4	11.3	--	--
27	3.7	13.9	6.5	11.8	7.8	11.5	--	--
30	3.7	13.9	6.5	11.7	7.9	11.9	--	--

* All Temperatures are in °C.

** DO is measured in mg/l.

Lake Saint-Francois
Quebec

Depth (m)	Station 29N7E				Station 23N14E			
	5/3/73		6/18/73		5/3/73		6/18/73	
	Temp*	DO**	Temp	DO	Temp	DO	Temp	DO
0	5.9	12.6	16.0	7.6	24.0	9.0	5.8	14.1
3	5.1	12.6	14.1	9.9	23.1	8.5	5.7	14.0
6	5.0	12.5	13.2	9.6	22.9	8.9	5.4	14.0
9	4.9	12.3	11.5	9.1	20.0	7.2	5.2	13.5
12	4.3	12.0	9.9	9.1	12.0	6.0	5.0	13.3
15	--	--	--	--	--	--	5.0	13.3
18	--	--	--	--	--	--	5.0	13.2
21	--	--	--	--	--	--	5.0	13.2
24	--	--	--	--	--	--	5.0	13.2
27	--	--	--	--	--	--	5.0	13.2
30	--	--	--	--	--	--	5.0	13.1

Depth (m)	Station 10N18E			
	5/3/73		6/18/73	
	Temp	DO	Temp	DO
0	5.4	14.0	17.0	9.5
3	5.2	13.8	16.0	9.8

* All temperatures are in °C.

** DO is measured in mg/l.

Lake Saint-Francois (Continued)

		Station 10N18E				Station 23N14E											
		5/3/73		6/18/73		8/3/73		5/11/74		5/11/75		3/23/76		4/28/76		8/11/76	
Depth (m)		Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
6		5.0	13.7	15.6	9.9	21.5	8.0										
9		4.9	13.5	15.0	10.0	16.0	7.4										
12		4.8	13.4	11.0	11.0	12.5	8.0										
15		4.8	13.3	9.0	11.0	10.0	8.0										
18		4.8	13.2	9.0	11.0	9.0	7.8										
21		4.8	13.1	8.3	10.9	8.6	7.2										
24		4.8	--	8.3	10.6	8.4	7.0										
27		--	--	8.3	10.4	--	--										
30		--	--	8.3	10.2	--	--										

A18

Lake Saint-Francois (Concluded)

Depth (m)	8/27/74				5/11/75				3/23/76				Station 23N14E				4/28/76				8/11/76				
	Temp		DO		Temp		DO		Temp		DO		Temp		DO		Temp		DO		Temp		DO		
	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
5	20.5	8.9	1.8	12.2	2.0	12.1	3.4	11.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
7	20.5	9.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
9	19.5	8.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
10	19.0	8.4	2.5	12.1	2.5	11.6	3.4	11.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11	17.0	7.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
12	13.0	6.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
15	10.2	7.1	2.5	11.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
20	8.0	7.3	2.7	10.5	3.0	10.0	3.5	11.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
25	--	--	3.0	9.6	3.2	9.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
26	--	--	--	--	--	--	3.3	9.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
28	--	--	3.1	7.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
30	7.1	6.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
34	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
35	7.0	6.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
36	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

A19

Lake Aylmer
Quebec

Depth (m)	Station 11N4E				Station 9N9E			
	5/2/73		6/11/73		8/13/73		6/11/73	
	Temp	DO**	Temp	DO	Temp	DO	Temp	DO
0	6.0	13.5	--	9.0	24.1	6.9	7.0	13.3
3	6.0	13.4	16.9	9.0	23.2	7.0	5.9	13.5
6	5.5	13.2	16.2	9.0	22.3	7.5	5.8	13.5
9	5.0	13.1	13.6	9.1	16.5	5.3	5.8	13.3
12	5.0	13.1	11.5	9.5	12.0	6.5	5.8	13.2
15	5.0	13.0	9.5	9.5	11.0	7.0	5.5	13.2
18	5.0	13.0	9.0	10.0	10.3	7.0	--	--
21	5.0	13.0	9.0	10.1	10.0	7.0	--	--
24	5.0	13.0	9.0	10.1	10.0	7.0	--	--
27	--	13.0	--	9.9	10.1	6.9	--	--

Depth (m)	Station 19N8E				Station 11N4E			
	5/2/73		6/11/73		8/13/73		5/11/75	
	Temp	DO	Temp	DO	Temp	DO	Temp	DO
0	7.5	13.5	17.8	10.3	24.3	5.8	--	--
1	--	--	--	--	--	--	1.0	15.6
2	--	--	--	--	--	--	20.5	8.8
3	5.8	13.9	17.2	10.0	23.1	5.9	1.0	15.4
4	--	--	--	--	--	--	20.5	8.9
5	--	--	--	--	--	--	--	--
6	5.3	13.1	15.5	10.0	22.8	5.8	20.5	9.0

Lake Aylmer (cont'd)

Depth (m)	Station 19N8E				Station 11N4E			
	5/2/73 Temp	DO**	6/11/73 Temp	DO	8/13/73 Temp	DO	3/12/74 Temp	DO
8	--	--	--	--	--	--	1.5	13.5
9	5.2	13.2	12.5	10.0	16.0	5.0	--	20.5
10	--	--	--	--	--	--	20.0	9.7
11	--	--	--	--	--	--	13.5	6.0
12	5.1	13.5	11.1	10.1	12.0	5.5	--	11.5
13	--	--	--	--	--	--	10.0	7.0
15	5.0	13.3	10.5	10.2	10.2	5.5	--	9.4
17	--	--	--	--	--	--	8.5	7.2
18	5.0	13.1	9.9	10.1	10.9	5.5	2.0	12.9
20	--	--	--	--	--	--	--	--
21	--	--	9.2	9.9	10.1	5.6	--	7.5
23	--	--	--	--	--	2.0	11.6	--
24	--	--	9.4	9.2	--	--	--	--
25	--	--	--	--	--	--	--	2.2
28	--	--	--	--	--	2.0	9.4	9.2
						7.5	6.5	7.4

Lake Aylmer (concluded)

Depth (m)	11/11/75				3/23/76				4/28/76				Station 11N4E			
	Temp*	D0**	Temp	D0	Temp	D0	Temp	D0	Temp	D0	Temp	D0	Temp	D0	Temp	D0
0	8.1	10.8	--	--	3.6	11.6	--	--	--	--	--	--	--	--	--	--
1	--	--	--	--	3.6	11.5	20.1	8.3	--	--	--	--	--	--	--	--
2	--	--	1.0	13.2	--	--	19.5	8.3	--	--	--	--	--	--	--	--
4	--	--	--	--	--	--	19.0	8.1	--	--	--	--	--	--	--	--
5	8.1	10.8	1.7	12.6	3.6	11.2	--	--	--	--	--	--	--	--	--	--
6	--	--	--	--	--	--	19.0	8.2	--	--	--	--	--	--	--	--
8	--	--	--	--	--	--	18.7	8.2	--	--	--	--	--	--	--	--
10	8.1	10.8	2.9	11.9	3.5	11.2	18.4	8.2	--	--	--	--	--	--	--	--
12	--	--	--	--	--	--	13.0	6.2	--	--	--	--	--	--	--	--
15	8.1	10.8	3.0	11.4	--	--	10.5	6.7	--	--	--	--	--	--	--	--
20	8.1	10.8	3.3	10.4	3.5	11.1	--	--	--	--	--	--	--	--	--	--
22	--	--	--	--	--	--	9.8	6.5	--	--	--	--	--	--	--	--
23	8.1	10.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--
24	--	--	3.4	8.6	--	--	--	--	--	--	--	--	--	--	--	--
25	--	--	3.4	8.4	3.5	11.0	--	--	--	--	--	--	--	--	--	--
27	--	--	--	--	3.6	10.8	--	--	--	--	--	--	--	--	--	--

* Temperatures are in °C.

** DO is measured in mg/l.

Lake Mégantic
Québec

Depth (m)	Station 4N7E				Station 8N7E			
	4/25/73		6/4/73		8/6/73		6/4/73	
	Temp*	DO**	Temp	DO	Temp	DO	Temp	DO
0	5.1	12.9	10.8	11.5	23.0	8.8	3.5	11.2
3	5.0	13.0	10.0	11.5	20.0	9.0	3.8	12.9
6	4.5	12.8	9.6	12.0	16.0	8.0	3.8	12.0
9	4.1	12.8	9.1	12.0	11.0	9.0	3.8	12.2
12	4.0	12.6	8.5	12.0	9.5	9.7	3.8	12.2
15	4.0	12.6	8.7	11.1	8.9	9.9	3.8	12.2
18	--	--	--	--	--	--	3.8	12.2
21	--	--	--	--	--	--	--	--
Station 14N7E								
Depth (m)	4/25/73				8/6/73			
	Temp	DO	Temp	DO	Temp	DO	Temp	DO
	0	3.0	12.9	9.9	11.9	22.2	8.1	3.1
3	3.0	12.9	9.0	12.1	21.9	8.8	3.0	13.0
6	3.0	12.9	8.1	11.9	20.8	8.8	2.9	13.0
9	3.0	12.9	7.2	12.0	18.0	7.2	2.9	13.0
12	3.0	13.0	6.6	12.0	10.0	8.6	2.9	13.0
Station 21N4E								
Depth (m)	4/25/73				6/4/73			
	Temp	DO	Temp	DO	Temp	DO	Temp	DO
	0	3.0	12.9	9.9	11.9	22.2	8.1	3.1
3	3.0	12.9	9.0	12.1	21.9	8.8	3.0	13.0
6	3.0	12.9	8.1	11.9	20.8	8.8	2.9	13.0
9	3.0	12.9	7.2	12.0	18.0	7.2	2.9	13.0
12	3.0	13.0	6.6	12.0	10.0	8.6	2.9	13.0

* All temperatures are in °C.

** DO is measured in mg/l.

Lake Mégarthic (Concluded)

Depth (m)	Station 14N7E				Station 21N4E			
	4/25/73		6/4/73		4/25/73		6/4/73	
	Temp	DO	Temp	DO	Temp	DO	Temp	DO
15	3.0	12.9	6.5	12.0	8.9	9.0	2.9	13.0
18	3.0	12.8	6.2	12.0	8.7	9.0	2.9	13.0
21	3.0	13.0	6.0	12.0	8.5	9.0	2.9	13.0
24	3.0	13.0	5.9	12.0	8.2	9.0	2.9	12.9
27	3.0	13.0	6.0	11.9	8.5	9.0	2.9	12.8
30	3.1	12.9	6.0	11.7	8.7	9.0	2.8	12.6

Lake Montagne Tremblante
Quebec

<u>Depth (m)</u>	5/3/76		8/2/76	
	<u>Temp*</u>	<u>D0**</u>	<u>Temp</u>	<u>D0</u>
0	4.0	11.4	19.5	8.8
1	4.0	11.3	19.5	8.8
3	--	--	19.2	8.9
5	4.0	11.2	19.0	9.0
7	--	--	19.0	9.1
10	--	--	9.5	10.4
12	--	--	8.5	10.4
15	--	--	8.0	10.6
20	4.0	11.2	7.2	10.6
30	4.0	11.1	6.3	10.6
40	4.0	11.0	6.0	10.7
48	4.0	10.9	--	--
50	--	--	5.5	10.7
60	--	--	5.5	10.6
73	--	--	5.5	10.4
74	4.0	11.8	--	--

* All temperatures are in $^{\circ}\text{C}$.

** DO is measured in mg/l.

Lake Trois Montagne
Quebec

<u>Depth (m)</u>	5/3/76		8/3/76	
	<u>Temp*</u>	<u>DO**</u>	<u>Temp</u>	<u>DO</u>
0	5.5	10.6	20.0	9.4
1	5.5	10.7	20.0	9.5
5	5.3	10.5	19.5	9.7
10	5.2	10.4	7.7	10.5
20	--	--	5.9	9.5
30	4.5	9.7	--	--
40	4.3	9.6	5.5	9.1
48	4.2	9.3	5.5	8.8

* All temperatures are in $^{\circ}\text{C}$.

** DO is measured in mg/l.

Lake Labelle
Quebec

<u>Depth (m)</u>	<u>5/5/76</u>		<u>8/4/76</u>	
	<u>Temp*</u>	<u>DO**</u>	<u>Temp</u>	<u>DO</u>
0	5.2	10.4	20.0	8.8
1	5.2	10.4	20.0	8.9
3	--	--	19.9	9.0
5	5.2	10.4	19.4	9.0
7	--	--	14.5	9.1
8	--	--	12.0	9.3
10	5.1	10.4	10.0	9.6
15	--	--	8.3	10.0
20	5.2	9.8	7.0	10.0
30	--	--	6.5	9.9
40	5.0	10.0	6.1	9.8
48	4.6	9.4	--	--
50	--	--	6.1	9.7
54	--	--	5.3	9.6

* All temperatures are in $^{\circ}\text{C}$.

** DO is measured in mg/l.

Lake Sieze Iles
Quebec

<u>Depth (m)</u>	5/5/76		7/29/76	
	<u>Temp*</u>	<u>DO**</u>	<u>Temp</u>	<u>DO</u>
0	5.4	10.2	21.3	9.2
1	5.4	10.2	21.3	9.2
4	--	--	20.5	9.4
5	5.4	10.2	--	--
6	--	--	16.8	11.1
8	--	--	10.7	10.3
10	5.3	10.0	8.8	9.4
20	--	--	6.5	8.2
30	4.8	9.3	5.3	8.5
40	4.3	8.4	5.0	8.2
47	--	--	5.0	7.8
48	4.1	8.2	5.0	7.8

* All temperatures are in $^{\circ}\text{C}$.

** DO is measured in mg/l.

Cayuga Lake (Sampling Stations)

New York

Milliken Central

<u>Date</u>	<u>Depth (m)</u>	<u>Temp*</u>	<u>DO**</u>
10/23/70	0	11.0	10.6
	5	--	10.6
	10	10.8	10.4
	30	9.0	10.4
11/2/71	0	15.0	9.6
	5	15.0	9.9
	120	6.0	9.8
8/2/72	120	5.5	9.1
8/14/72	120	5.5	11.7
8/22/72	120	5.0	9.1
9/21/72	120	4.3	10.1

Glenwood

<u>Date</u>	<u>Depth (m)</u>	<u>Temp</u>	<u>DO</u>
7/31/72	75	5.5	11.3
8/9/72			11.2
8/16/72			11.2
8/24/72			11.7

Taughannock Central

<u>Date</u>	<u>Depth (m)</u>	<u>Temp</u>	<u>DO</u>
10/23/70	0	10.5	10.8
	5	--	10.7
	10	10.0	10.6
	30	8.6	10.4
11/21/71	0	15.5	10.0
	5	15.5	10.5
	113	10.0	9.8
10/5/71	0	17.5	10.0

(Continued)

* All temperatures are in $^{\circ}\text{C}$.

** DO is measured in mg/l.

Cayuga Lake (Concluded)

Taughannock Central (Concluded)			
<u>Date</u>	<u>Depth (m)</u>	<u>Temp</u>	<u>DO</u>
10/5/71	5	17.5	10.3
(Con't)	10	17.8	9.8
	113	--	9.9
9/11/71	0	22.0	--
	15	17.0	7.7
	21	10.0	9.3
	107	4.5	5.7
7/31/72	113	5.0	11.1
8/7/72		5.0	10.0
8/14/72		5.0	10.3
8/22/72		5.5	10.7
9/21/72		4.3	9.8

Sheldrake			
<u>Date</u>	<u>Depth (m)</u>	<u>Temp</u>	<u>DO</u>
10/5/71	0	--	9.9
	5	--	8.7
	10	18.0	10.0
	118.5	8.0	9.0
7/8/72	0	25.0	8.0
	5	22.0	8.1
	10	19.0	8.4
	118.5	6.0	3.4
8/2/72		5.0	7.8
8/22/72		5.0	7.9
9/21/72		5.0	11.0

Cayuga Lake (Taughannock Station)
New York

Depth (m)	6/21/50		6/23/50		6/27/50		7/7/50		7/17/50		7/28/50	
	Temp*	DO**	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
0	13.3	8.0	15.0	7.7	17.2	7.6	18.9	6.0	18.9	6.9	20.6	4.5
10	10.0	8.0	10.0	7.55	12.8	8.1	17.8	7.05	16.7	6.6	18.9	6.0
20	6.67	8.0	8.33	7.5	7.78	8.1	11.7	7.8	9.44	7.35	14.4	6.6
30	5.56	--	7.22	7.8	6.11	8.5	6.67	8.0	7.78	8.5	6.67	7.75
40	5.00	--	6.11	--	6.11	8.05	5.56	8.3	6.11	7.05	6.11	8.2
50	5.00	--	5.56	8.65	5.00	8.6	5.00	8.9	5.56	7.45	5.56	8.15
60	5.00	--	5.00	8.7	5.00	8.4	5.00	8.6	5.00	7.4	5.00	8.5
70	--	--	--	--	--	--	--	--	--	--	--	8.35
80	--	--	--	--	--	--	--	--	--	--	--	7.6
90	--	--	--	--	--	--	--	--	--	--	--	7.75
100	--	--	--	--	--	--	--	--	--	--	--	8.6
8/11/50												
Depth (m)	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
0	22.8	6.85	22.8	6.6	21.7	8.8	21.1	9.0	18.9	9.45	13.9	11.3
10	20.0	--	18.9	--	20.0	8.75	20.6	9.0	18.3	9.35	13.3	--
20	13.9	6.85	13.9	6.9	13.9	8.85	7.78	10.8	16.7	8.95	13.3	11.2

* All temperatures are in °C.

** DO is measured in mg/l.

Cayuga Lake (Continued)

Depth (m)	8/11/50		8/18/50		8/29/50		9/6/50		9/20/50		10/20/50	
	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
30	7.78	--	8.33	--	7.78	--	6.11	--	10.6	--	10.6	--
40	6.11	8.4	6.67	8.35	6.67	10.8	5.56	11.75	7.78	11.0	6.67	11.55
50	5.56	--	5.56	--	6.11	--	5.56	--	6.67	--	6.11	--
60	5.00	8.5	5.00	8.65	5.00	10.8	5.00	12.1	5.56	11.55	5.56	11.25
70	--	--	--	--	--	--	--	--	--	--	--	--
80	--	8.5	--	--	--	10.95	--	11.9	--	10.7	--	--
90	--	--	--	--	--	--	--	--	--	--	--	--
100	--	8.3	--	--	--	9.5	--	11.45	--	10.55	--	--
<hr/>												
Depth (m)	10/27/50	11/14/50	5/15/51	5/22/51	6/12/51	6/21/51						
	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
0	12.8	11.15	10.6	11.65	8.33	10.07	13.9	12.16	11.7	11.47	14.4	11.07
10	12.8	--	10.6	--	6.67	--	6.11	--	10.0	11.76	10.6	--
20	12.8	10.8	10.6	11.35	6.67	11.76	6.67	11.86	10.0	11.81	8.33	11.22
30	12.2	--	10.6	--	6.11	--	5.56	--	7.78	--	6.11	--
40	7.22	11.15	10.6	11.35	5.56	11.86	5.00	11.86	7.22	11.81	5.56	11.56
50	6.11	--	7.78	--	5.56	--	4.44	--	6.67	--	5.00	--
60	5.56	11.25	6.11	11.55	4.44	11.86	4.44	11.86	6.11	11.86	5.00	11.56

Lake Cayuga (Continued)

Depth (m)	10/27/50		11/14/50		5/15/51		5/22/51		6/12/51		6/21/51	
	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
70	--	--	--	--	3.89	--	4.44	--	5.00	--	5.00	--
80	--	--	--	11.75	3.89	11.96	4.44	11.86	4.44	11.86	4.44	11.66
90	--	--	--	--	3.89	--	4.44	--	4.44	--	4.44	--
100	--	--	--	11.55	3.89	11.66	4.44	11.61	--	--	4.44	11.47
<hr/>												
Depth (m)	7/11/51		7/21/51		7/27/51		8/1/51		8/8/51		8/20/51	
	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
0	--	9.79	21.1	8.8	23.3	9.14	24.4	8.8	20.6	8.7	24.4	9.39
10	--	--	15.6	--	19.4	--	18.9	--	17.8	--	17.8	--
20	--	9.88	10.0	9.54	12.2	9.69	14.4	9.14	12.8	9.29	12.8	9.09
30	--	--	7.22	--	9.44	--	9.44	--	9.44	--	8.33	--
40	--	10.72	6.11	10.87	6.67	10.77	6.67	10.67	7.78	10.63	6.11	10.48
50	--	--	5.56	--	5.56	--	5.56	--	6.11	--	5.56	--
60	--	11.42	5.00	10.97	5.56	11.17	5.56	10.97	5.56	10.97	5.56	11.07
70	--	--	5.00	--	--	--	5.56	--	5.56	--	--	--
80	--	11.37	5.00	10.92	--	11.12	5.56	11.32	5.00	11.17	--	11.27
90	--	--	5.00	--	--	--	5.00	--	5.00	--	--	--
100	--	11.07	5.00	10.67	--	10.72	5.00	10.67	5.00	10.97	--	10.28

Cayuga Lake (Continued)

Depth (m)	8/29/51		10/18/51		11/13/51		3/18/52		4/26/52		5/23/52	
	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
0	25.1	9.39	15.0	9.8	10.0	9.8	2.78	10.7	4.44	10.3	8.89	10.8
10	20.6	--	13.9	--	10.0	--	2.78	10.6	4.44	--	7.78	10.9
20	12.8	9.24	13.9	8.9	9.44	--	2.78	--	4.44	10.1	7.22	12.1
30	7.78	--	9.44	--	7.22	--	2.78	--	4.44	--	6.67	--
40	6.11	10.72	7.22	9.8	6.67	--	2.78	--	4.44	--	6.11	11.3
50	5.56	--	6.67	--	6.11	--	2.78	--	4.44	--	6.11	--
60	5.56	10.92	5.56	9.9	5.56	--	2.78	--	4.44	10.4	5.00	11.5
70	--	--	--	--	5.56	--	--	--	--	--	--	--
80	--	10.97	--	10.2	5.56	--	--	--	--	--	--	--
90	--	--	--	--	5.56	--	--	--	--	--	--	--
100	--	10.28	--	10.1	5.56	--	--	--	10.4	--	12.2	--
<hr/>												
6/24/52		7/31/52		8/15/52		9/24/52		7/2/68				
Depth (m)	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
0	15.6	7.8	23.3	7.7	22.8	1	19.4	9.15	16.2	10.70		
10	12.2	9.0	21.7	8.6	21.7	7.9	20.0	9.1	15.0	9.22		
20	9.44	9.1	11.7	9.0	12.2	9.2	18.9	8.8	11.0	9.48		
30	8.33	--	7.22	--	9.44	--	10.6	--	9.9	10.14		

Cayuga Lake (Continued)

Depth (m)	6/24/52		7/31/52		8/15/52		9/24/52	
	Temp	DO	Temp	DO	Temp	DO	Temp	DO
40	7.22	9.4	6.11	9.6	7.78	10.0	7.22	10.4
50	6.67	--	5.56	--	6.11	--	6.11	--
60	6.11	9.4	5.00	9.8	5.56	10.5	6.11	10.95
70	--	--	5.00	--	5.56	--	5.56	--
80	--	9.6	5.00	9.5	5.00	9.2	5.00	10.4
90	--	--	5.00	--	5.00	--	5.00	--
100	--	--	5.00	9.2	5.00	8.5	5.00	9.0

Depth (m)	7/16/68		8/8/68		8/20/68		9/6/68	
	Temp	DO	Temp	DO	Temp	DO	Temp	DO
0	23.1	10.65	20.7	8.74	20.4	8.68	20.2	8.70
10	14.0	9.56	17.8	8.51	17.8	8.63	19.1	7.95
20	10.0	10.01	10.4	9.53	10.1	9.57	9.9	8.92
30	8.5	10.62	6.9	10.81	6.4	10.48	6.2	10.24
40	5.5	11.10	5.6	11.05	5.6	10.80	5.3	10.10
50	--	--	4.7	10.80	5.1	--	4.4	10.70
60	--	--	4.3	11.30	4.5	10.93	--	11.25
70	--	--	4.1	10.80	4.5	10.90	--	10.78
80	--	--	--	--	--	10.55	--	10.30
90	--	--	--	10.20	--	11.40	--	11.20
100	--	--	--	10.20	--	10.50	--	9.86
110	--	--	--	8.47	--	8.38	--	8.10

Cayuga Lake (Continued)

Depth (m)	9/20/68		10/17/68		10/30/68		11/14/68		11/26/68		1/21/69	
	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
0	18.7	9.05	16.3	9.58	11.7	9.15	9.4	9.78	6.2	10.22	3.5	11.70
10	17.9	8.00	15.6	8.76	12.8	--	9.8	9.65	6.2	--	3.5	--
20	12.0	9.00	13.9	8.58	12.8	8.96	10.0	9.63	6.2	--	3.4	--
30	7.0	10.11	8.2	9.36	10.7	9.31	8.4	9.42	6.2	10.10	3.5	11.80
40	5.3	10.55	6.1	10.05	8.7	9.70	7.4	9.60	6.2	10.10	3.5	11.53
50	4.4	10.60	5.2	10.60	7.0	10.12	6.9	10.40	6.2	--	3.5	--
60	4.2	10.66	4.7	10.66	5.1	10.20	6.3	9.98	5.9	9.9	3.5	11.67
70	--	10.97	4.5	10.50	4.6	10.80	5.8	10.00	5.9	10.00	3.5	11.50
80	--	10.80	4.5	10.30	--	10.20	5.2	10.50	5.8	--	3.7	--
90	--	10.53	4.5	--	--	9.90	4.5	9.95	5.7	9.87	3.8	11.40
100	--	9.68	4.5	8.45	--	8.40	4.5	8.75	5.7	9.30	3.8	11.50
110	--	7.30	--	6.70	--	8.45	--	7.50	--	--	--	--

Cayuga Lake (Concluded)

Depth (m)	2/17/69		3/18/69		4/15/69	
	Temp	DO	Temp	DO	Temp	DO
0	1.6	12.20	2.1	12.36	2.9	12.13
10	1.6	--	2.1	--	2.9	--
20	1.6	--	1.9	--	2.9	--
30	1.9	12.26	1.8	12.30	2.9	12.23
40	1.9	12.35	1.8	12.35	2.9	12.25
50	2.0	12.25	1.7	12.35	2.8	12.35
60	2.0	12.25	1.7	12.30	2.5	12.35
70	2.0	12.10	1.7	12.30	2.5	--
80	2.0	--	1.8	12.40	2.3	--
90	2.0	12.25	1.8	12.30	2.3	12.25
100	2.0	12.20	1.7	12.20	2.2	12.30

Finger Lakes
New York

Otisco			
Date	Depth (m)	Temp*	DO**
4/23/73	s	11.0	11.9
	b	6.5	12.2
7/17/73	s	23.0	7.6
	b	10.0	3.6
8/28/73	s	23.0	7.3
	b	10.5	2.3
Canadice			
Date	Depth (m)	Temp	DO
4/24/73	s	10.0	11.9
	b	6.0	8.9
7/18/73	s	23.0	8.3
	b	8.0	6.1
8/28/73	s	24.0	8.9
	b	8.5	3.6
Honeoye			
Date	Depth (m)	Temp	DO
4/24/73	s	12.5	10.9
	b	10.2	8.7
7/18/73	s	24.0	7.6
	b	22.4	6.7
8/28/73	s	25.0	10.3
	b	22.0	8.8
Keuka			
Date	Depth (m)	Temp	DO
4/25/73	s	7.6	12.1
	b	4.9	12.3
7/18/73	s	25.0	8.6
	b	6.0	7.3
8/28/73	s	23.5	10.0
	b	5.7	7.9

* All temperatures are in $^{\circ}\text{C}$.

** DO is measured in mg/l.

Finger Lakes (Continued)

Seneca			
Date	Depth (m)	Temp	DO
4/28/73	s	5.6	12.7
	b	4.0	12.2
7/18/73	s	23.5	9.2
	b	4.0	10.2
8/28/73	s	23.5	8.9
	b	5.5	9.2
Hemlock			
Date	Depth (m)	Temp	DO
7/26/72	--	27.2	--
9/13/72	--	9.5	2.0
4/24/73	s	11.4	9.7
	b	7.0	11.3
7/18/73	s	22.8	9.1
	b	9.2	4.9
7/30/73	--	26.0	--
8/28/73	s	24.2	9.5
	b	9.1	5.9
9/17/73	--	9.0	3.8
Owasco			
Date	Depth (m)	Temp	DO
7/21/72	--	26.0	--
8/4/72	--	6.0	6.7
4/23/73	s	3.5	12.9
	b	4.8	12.9
7/9/73	--	24.4	--
7/17/73	s	22.8	8.1
	b	6.8	8.0

Finger Lakes (Concluded)

Owasco (Continued)			
<u>Date</u>	<u>Depth (m)</u>	<u>Temp</u>	<u>D0</u>
8/28/73	s	23.5	8.4
	b	6.4	8.9
9/25/73	--	6.4	6.5

Skaneateles			
<u>Date</u>	<u>Depth (m)</u>	<u>Temp</u>	<u>D0</u>
7/21/72	--	27.0	--
9/20/72	--	6.0	8.3
4/23/73	s	6.0	12.7
	b	4.5	12.8
7/17/73	s	22.3	8.2
	b	6.0	11.1
7/25/73	--	6.0	10.4
8/14/73	--	23.5	--
8/28/73	s	22.8	8.7
	b	4.8	10.7